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A SELF-STUDY COURSE IN FORTRAN PROGRAMING

Volume II - Workbook

by Valmer Norrod, Sheldon Blecher, and Martha Horton

Prepared by
COMPUTER SCIENCES CORPORATION
El Segundo, Calif.
for Langley Research Center

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ABSTRACT

This two-volume manual is a comprehensive course in FORTRAN programing. Beginning with number systems and basic concepts, it proceeds systematically through the elements of the FORTRAN language and concludes with a discussion of programing techniques such as flow charting and debugging. Volume I is organized as a programed textbook with frequent checkpoints and abundant examples. Exercises and answers referred to in Volume I are contained in the Workbook - Volume II. Written for training programers at the NASA Langley Research Center, the manual is based on Control Data FORTRAN 2.3, but it is generally applicable to other versions.

FOREWORD

This manual was developed by Computer Sciences Corporation for training FORTRAN programers at the NASA Langley Research Center. While it is a description of Control Data FORTRAN 2.3 structured for self-study, it is generally applicable to other versions of FORTRAN.

The following personnel of the Langley Research Center worked closely with the contractor and made major contributions to the document: Lessie D. Hunter, Margaret A. Ridenhour, Nancy L. Taylor, and Dorothy J. Vaughan. Prior to publication, the manual has been used by more than 100 people and has proved to be very effective.

It is suitable for use by an individual studying alone, or as the basis for informal group study. When used as a group text, experience has shown that the study is more effective if it is supplemented by periodic reviews by a course monitor and concluded with a final examination.

Parts I - IV are intended to cover the basic elements of the FORTRAN language and may be used as a course for the engineer or manager interested in acquiring only a basic knowledge of the language but not intending to progress into actual programing work.

Roger V. Butler
Head, Computational Techniques Section
Langley Research Center

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A SELF-STUDY COURSE IN FORTRAN PROGRAMING

Volume II - Workbook

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Computer Sciences Corporation

Exercise II. A

1. Write the five arithmetic operations and the FORTRAN symbol(s) used to denote these operations.

	Operations	Symbols
1)	_____	_____
2)	_____	_____
3)	_____	_____
4)	_____	_____
5)	_____	_____

2. A variable name must not contain more than _____ characters.

3. The first character in a variable name must be a _____.

4. Indicate the operation which is performed first in each expression.

1)	A**2+C	_____
2)	(A**2+D)**2	_____
3)	FORCE+TEMP/OVER	_____
4)	A*(-D)+C	_____
5)	((K-L)+J)*L	_____

5. FORTRAN statements must not start before column _____ in the coding form.

Exercise II. A (Continued)

6. If a FORTRAN statement is not complete when column 72 has been used, a _____ card may be used.

7. The expression within the innermost set of parentheses is evaluated _____ (first, last).

8. A statement number can be any integer in the range 1 through _____.

9. If no parentheses are present, the operation which is performed first on a left to right basis is _____.

10. A continuation card is indicated by a non-zero punch in column _____.

11. Write two FORTRAN statements on the coding form below. The first statement will use the known circumference of a circle to compute the radius. The next statement will compute the area. The equations involved are

$$r = \frac{c}{2\pi} \quad \text{and} \quad a = \pi r^2$$

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80
		C=225.6	
		PI =3.14159265	
C		NOW COMPUTE THE RADIUS AND AREA	

Exercise II. A (Continued)

12. Write the equivalent algebraic expression from each of the following FORTRAN expressions.

1) A+B*C/D*F+G**2/R _____

2) 3.0*PHI**2/D*C-P _____

3) A/B*C*D-4.0/A*F _____

4) X**2/Y*C+Y**2/X*A _____

5) G*T**2/C/D-A*B _____

Exercise II. B

1. Two types of variables and constants were discussed in section II. B. These two types are _____ and _____.

2. Since most computations require fractional values, the evaluation of most expressions will be done in the _____ _____ mode.

3. If no type statements are used, all variables which begin with the letters _____, _____, _____, _____, _____ and _____ will be considered integers.

4. A variable is distinguished from a constant by the fact that a variable must begin with a _____.

5. A real constant is distinguished from an integer constant by the presence of a _____ _____.

6. Write the mathematical equation $y = \dfrac{x^2 - 3x + 1}{x(x-1)^2}$ as a FORTRAN statement. Use the current value of x and assign the result to the variable y.

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	7–50 FORTRAN STATEMENT	73–80
C		WRITE YOUR STATEMENT ON NEXT LINE	

7. Write the values below as real constants. In doing this please eliminate long strips of leading or trailing zeros.

1.) $.96 \times 10^{-4}$ _____

2.) 20 _____

3.) 20.6×10^{2} _____

4.) .00000008 _____

5.) 200000000. _____

8. Consider the two statements below and assume that they are to be evaluated in sequence.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont. (6)	FORTRAN STATEMENT (7–50)	(73–80)
10		X=20.0	
20		X=X+20.0	

The value of X after statement 10 has been evaluated is _____. The value of X after statements 10 and 20 have been evaluated is _____.

Exercise II. B (Continued)

9. The power of 10 used in writing a real constant must always be a positive or negative _____.

10. If L = 29 and K = 5, the result of the expression L/K in FORTRAN is _____.

Exercise II. C

For each of the following statements, outline the sequence of steps required to carry out the required computation. If the mode is mixed, convert the variable to appropriate mode just before using it. The first one is worked out as an example.

1. I = 4.0*Y**2-((J-K)*X)/D

1.) K is subtracted from J in the fixed-point mode.
2.) The result of step 1 is converted to floating-point.
3.) The result of step 2 is multiplied by X.
4.) Y is squared.
5.) The result of step 4 is multiplied by 4.0.
6.) The result of step 3 is divided by D.
7.) The result of step 6 is subtracted from the result of step 5.
8.) The result of step 7 is converted to fixed-point.
9.) The result of step 8 is assigned to I.

2. Z = JJ - KK

1.) _____
2.) _____
3.) _____

3. X = Z**2/4.0*A*C + L*Y*SIGMA

1.) _____
2.) _____

Exercise II.C (Continued)

3.

3.) _____
4.) _____
5.) _____
6.) _____
7.) _____
8.) _____
9.) _____

4. POLY = (((3.2*K+1.5)*X+4.1)*X+26.0)

1.) _____
2.) _____
3.) _____
4.) _____
5.) _____
6.) _____
7.) _____
8.) _____

5. SLOPE = (Y4-Y3)/(X4-X3)

1.) _____
2.) _____
3.) _____
4.) _____

1. Suppose we have the matrix A of order 3 and wish to multiply it by the column vector B. This will result in the column vector C. In matrix notation this is

$$\underset{\text{Matrix A}}{\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}} \underset{\text{Vector B}}{\begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}} = \underset{\text{Vector C}}{\begin{pmatrix} c_1 \\ c_2 \\ c_3 \end{pmatrix}}$$

Matrix multiplication is defined for the above equation in the following manner.

$$c_1 = a_{11} b_1 + a_{12} b_2 + a_{13} b_3$$

$$c_2 = a_{21} b_1 + a_{22} b_2 + a_{23} b_3$$

$$c_3 = a_{31} b_1 + a_{32} b_2 + a_{33} b_3$$

Complete the DIMENSION statement and write the three FORTRAN statements required to calculate c_1, c_2, and c_3. This should be done using subscripted variables.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DIMENSION	
C		ASSUME THAT THE KNOWN VALUES ARE READ	
C		INTO THE COMPUTER HERE	

Exercise II.D (Continued)

2. If you had any trouble with problem 1, see if you follow the explanation which follows. First, we must decide on names for the three different variables involved. If we select A, B, and C, the DIMENSION statement should read DIMENSION A(3, 3), B(3), C(3). The first FORTRAN statement is then written C(1) = A(1, 1)*B(1)+A(1, 2)*B(2)+A(1, 3)*B(3)

Using the variable names A, B, and C and assuming that K has a value in the range 1, 2, or 3, write a FORTRAN statement that sets SUM equal to the sum of the elements in the Kth row of A.

_____

3. Suppose that the surface temperature of a lake is read every hour over a period of 90 days. One way of storing these values in a program is to use a two-dimensional array, T. Let the first subscript represent the day and the second subscript the hour. Thus, the temperature at hour five on the third day of observation is referenced T(3, 5).

The value of T(6, 10) is missing. Write the DIMENSION statement and then the FORTRAN statement which will set this value to the average of the 9th and 11th hour readings on the same day.

_____

_____

4. Using the same values as in number 3, write the FORTRAN statement which will set the value of T(6, 10) to the average of four readings. Two of these readings being at the same hour on the two previous days and the other two being at the same hour of the two following days.

_____

5. Using the two-dimensional array established in number 3, assume that the temperature had increased at a constant rate between hour 8 and hour 9 on day 66. Write the FORTRAN statement which assigns TEMP the temperature at 30 minutes past hour 8.

_____

6. Using the two-dimensional array established in number 3, write the statement which assigns DTEMP the value obtained by subtracting the temperature at hour 8 from the temperature at hour 9 on day 66.

_____

The above gives the change from hour 8 to hour 9. Now write the statement which assigns DTEMP one-half of this change.

_____

Exercise II. D (Continued)

6. The above added to the temperature at hour 8 gives the result asked for in number 5.

Now write the statement which assigns TEMP the value at 30 minutes past hour 8.

_____

Exercise II. E

1. List the five different types of variables and the seven different types of constants.

Variables	Constants
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
	_____
	_____

2. List the three different variable types which, if used, must appear in a type statement.

_____ , _____ , _____

3. A double precision constant differs from a real constant in that every constant must be written with a power of ten multiplier and this multiplier is denoted by D instead of E as with real constants. The double precision constant may have up to 29 digits while the real constant is limited to 15. Indicate the type of constant for each of the following:

1.) .25D0	_____	5.) .8E-4	_____
2.) .33	_____	6.) .8D-4	_____
3.) 17	_____	7.) 10	_____
4.) (25.0, 0.0)	_____	8.) .TRUE.	_____

Exercise II.E. (Continued)

4. The word length of the CDC 6600 computer is sixty binary digits. Since each octal digit converts to three binary digits, the maximum number of digits allowed in an octal constant is _____.

5. If fewer than twenty octal digits appear in an octal constant, the value entered is _____-adjusted in the computer word and _____ are filled in on the _____.

6. If $y = \frac{(3+4i)\ (-1+2i)}{(-1-i)\ (3-i)}$, write the computer program to compute the value of y. Remember that the complex constant (-1.0, 2.0) means (-1+2i).

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	7–50 FORTRAN STATEMENT	73–80

7. The _____ constant is used to store alphabetic information in a computer word. A unique _____ digit code is assigned to each letter, _____, or special character. If characters are entered, the entire computer word is filled. The constant 6HRADIUS will fill the left thirty-six binary digits of the computer word. The rightmost twenty-four binary digits will be filled with _____ blank characters.

8. A logical variable has the value .TRUE. when it is non-zero. When it is zero it is said to have the value _____.

Exercise II. F

1. The logical constant .TRUE. in binary form is a word of all 1's. The logical constant .FALSE. is a binary word of all zeros.

$$.\text{TRUE.} = 111111\cdots11111_2$$
$$.\text{FALSE.} = 000000\cdots00000_2$$

Considering the binary digits of the two constants, indicate a .TRUE. or .FALSE. result for each of the following expressions.

1.)	.TRUE. .AND. .TRUE.	_____
2.)	.FALSE. .AND. .TRUE.	_____
3.)	.TRUE. .AND. .FALSE.	_____
4.)	.FALSE. .AND. .FALSE.	_____
5.)	.TRUE. .OR. .TRUE.	_____
6.)	.TRUE. .OR. .FALSE.	_____
7.)	.FALSE. .OR. .TRUE.	_____
8.)	.FALSE. .OR. .FALSE.	_____
9.)	.NOT. .TRUE.	_____
10.)	.NOT. .FALSE.	_____

2. It was mentioned that logical variables can have the value .TRUE. or the value .FALSE. . This leads to the question as to what happens when a logical variable occurs on the left side of the equal. If the value on the right side is zero, it is set to .FALSE. . If the value on the right is non-zero, it is set to .TRUE. In case the right hand side is double precision or complex, only the most significant and real parts respectively are used for the zero or non-zero test. Now consider the following statements.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)
		LOGICAL M, N, NCOM
		DOUBLE PRECISION X, Y
		COMPLEX C
		M=C
		N=X*Y
		NCOM=K

(73–80)

Indicate the value of the logical variables assuming the statements above are executed with the values given.

	K	X	Y	C	M	N	NCOM
1.)	2	0.D0	.02D-2	(10.0, 0.0)			
2.)	5	24.D0	0.0D0	(0.0, 20.0)			
3.)	0	200.D0	10.D2	(2.0, 0.0)			
4.)	100	0.0D0	0.0D0	(4.0, 5.0)			
5.)	0	1.0D10	50.D0	(0.0, 6.0)			

Exercise II. F (Continued)

3. Indicate in octal the value of the integer variable I after each of the following statements.

1.) I = O0000777 .OR. O0007000 _____
2.) I = O0000052 .AND. O0000050 _____
3.) I = .NOT. (.TRUE. .OR. O0000001) _____
4.) I = 5 .OR. 2 _____
5.) I = L .AND. K
where $L = 16_{10}$ and $K = 1_{10}$ _____

Exercise II. G

1. When different types of variables were mixed in logical operations, the operations were performed on the binary digits and no consideration was given to the types of variables involved. As you realized when working with arithmetic operations involving real and integer variables, certain variable types must be converted before meaningful evaluations can be performed.

2. A real value is converted to complex by using the real value as the real part of the complex number and setting the imaginary part to _____.

3. An integer is converted to complex by converting it to real form and then following the steps in 2. A real value is converted to double precision by making the real value the most significant part and setting the least significant part to _____.

4. Write the steps involved in executing the following statements. Convert each variable to the dominant mode just before using it. The first one is worked out as an example.

FORTRAN CODING FORM

C for Comment

Statement No (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DOUBLE PRECISION A	
		X = A* I	

1.) I is converted to double precision
2.) result of step 1 is multiplied by A
3.) convert result of step 2 to real
4.) assign result of step 3 to X.

Exercise II.G (Continued)

5.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		COMPLEX D	
		X=X*D+I	

1.)
2.)
3.)
4.)
5.)
6.)

6.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		COMPLEX C, D	
		C=D* X+Y	

1.)
2.)
3.)
4.)
5.)

7.

FORTRAN CODING FORM

C for Comment

Statement No (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		COMPLEX C,D	
		DIMENSION C(3)	
		D=(C(1)+C(2)+C(3))*J-1	

1.) _____
2.) _____
3.) _____
4.) _____
5.) _____
6.) _____
7.) _____

Exercise II. G (Continued)

8.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		COMPLEX F, G	
		DOUBLE PRECISION Y	
		F=Y*(X+4)-G	

NOTE: Double precision is converted to complex by dropping the least significant part and using the most significant part as the real part of the complex value. The imaginary part is set to zero.

1.) _____
2.) _____
3.) _____
4.) _____
5.) _____
6.) _____
7.) _____

Exercise II. H

This exercise is a review of the material presented in PART II of the manual.

1. The five arithmetic operations are:

1.) _____
2.) _____
3.) _____
4.) _____
5.) _____

2. Within the innermost set of parentheses, the operational hierarchy is:

1.) _____
2.) _____ and _____
3.) _____ and _____

3. The expression within the innermost set of parentheses is evaluated _____.

4. There are five different types of variables. List them.

1.) _____
2.) _____
3.) _____
4.) _____
5.) _____

Exercise II.H (Continued)

5. Three of the above variables are not needed in many programs. List the two which appear in almost all programs.

1.) _____
2.) _____

6. If both real variables and integer variables appear in an arithmetic expression, the result of the expression will be _____.

7. List the seven types of constants and give an example of each.

	Type of Constant	Example
1.)	_____	_____
2.)	_____	_____
3.)	_____	_____
4.)	_____	_____
5.)	_____	_____
6.)	_____	_____
7.)	_____	_____

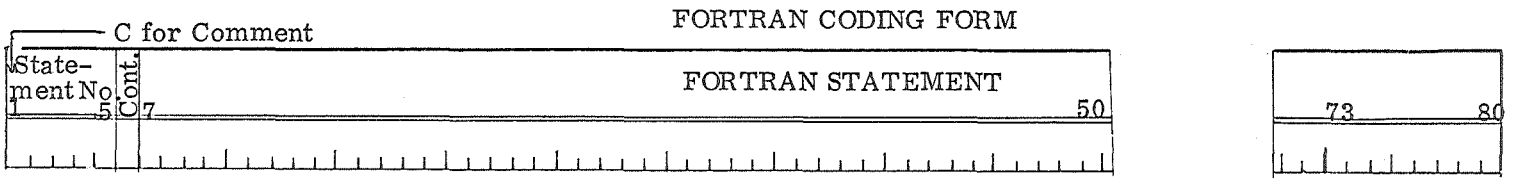
8. A variable which appears in a DIMENSION statement is called a _____ _____.

9. A subscript may be a simple arithmetic expression of integer constants and integer variables. True or false? _____

10. In the expression X(L(5))*Y, L(5) is a valid subscript. True or false? _____

11. A subscripted variable is not a valid subscript. Is a real variable a valid subscript? _____

12. Write a DIMENSION statement which will make A, B, and C into one-, two-, and three-dimensional arrays respectively. Make each array hold a maximum of 100 values.



13. If no type statements are used, real and integer variables are recognized by the first _____ in their names.

Exercise II. H (Continued)

14. Write type statements to declare POLY as double precision and CAPL as complex.

FORTRAN CODING FORM

C for Comment

Statement No 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

15. Three types of variables must always appear in a type statement. Name them.

1.) _____

2.) _____

3.) _____

Exercise III.B

1. In the following groups of statements, analyze the GO TO statement: (1) tell what kind it is (unconditional, assigned, or computed), and (2) write the statement number to which control will be transferred.

(a) I = 2
GO TO (7, 6, 5, 2), I

(kind)_____
(statement no.)_____

(b) ASSIGN 6 TO I
GO TO I

(kind)_____
(statement no.)_____

(c) I = 2
GO TO 6

(kind)_____
(statement no.)_____

(d) ASSIGN 20 TO INDEX
GO TO INDEX (35, 15, 20, 455, 200)

(kind)_____
(statement no.)_____

(e) J = 10
GO TO (10, 30, 65, 400, 10, 6, 8, 10, 10, 30, 10), J

(kind)_____
(statement no.)_____

Exercise III.B

2. Analyze the following program segments that use GO TO statements, and answer the questions with each:

(a)
```
      DIMENSION NTABLE (5, 5, 5)
      I = 1
      J = I + 1
      N = J + 1
      GO TO 30
      .
      .
   30 L = NTABLE (I, J, J)
      .
      .
```

After the above statements are executed, the variable L is set equal to the contents of NTABLE(_____, _____, _____).

(b)
```
      A = 4.0
      B = 3.0
      GO TO 50
      .
      .
   50 HYPOT = A**2 + B**2
```

After statement 50 has been executed, the value of HYPOT is _____ and the value of A is _____.

2. (Cont.) (c)

```
      ASSIGN 20 TO INDEX
   15 GO TO INDEX (20, 30, 40, 6)
   30 A = 1.0
      ASSIGN 40 TO INDEX
      GO TO 15
   20 A = 2.0
      ASSIGN 6 TO INDEX
      GO TO 15
   40 A = 3.0
      ASSIGN 30 TO INDEX
      GO TO 15
    6 (program continues)
```

1.) After this coding was executed, the last statement number assigned to INDEX was _____.

2.) The last value given to A was _____.

(d)

```
      DIMENSION ITABLE(50)
      M = 1
    2 GO TO (3, 1, 10, 50), M
    3 ITABLE(M) = M
      M = M+1
      GO TO 2
    1 GO TO 3
   10 GO TO 3
   50 (program continues)
```

1.) After this is executed, the value of M is _____.

2.) After this is executed, the value last placed in ITABLE(M) is _____.

Exercise III. B

2. (Cont.) (e)

```
      DIMENSION ITABLE(10)
      M = 1
    2 GO TO (3, 3, 3, 3, 3, 3, 3, 3, 3, 3, 50), M
    3 ITABLE(M) = M*2-1
      M = M + 1
      GO TO 2
   50 (program continues)
```

1.) After this is executed, the value in M is _____.

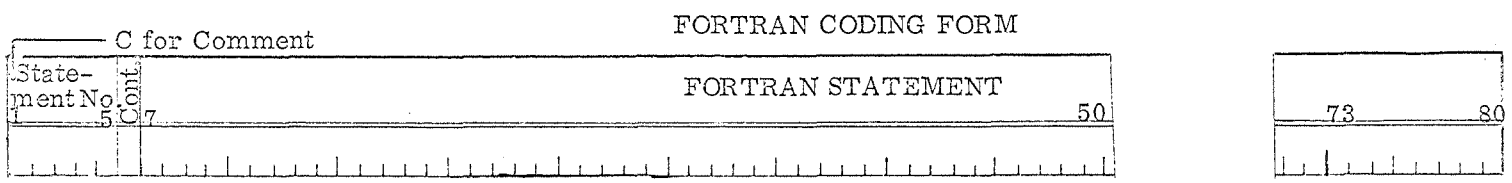
2.) List, in sequence, the values that are now in the 10 positions of ITABLE:

_____, _____, _____, _____, _____, _____, _____, _____, _____, _____

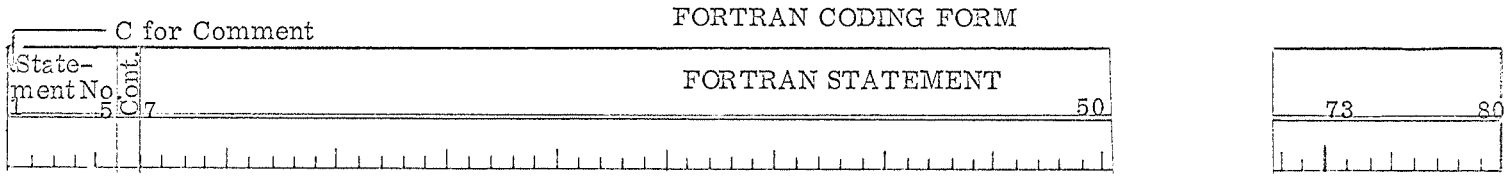
3. The following statements contain coding errors and/or logic errors. Rewrite the incorrect line or lines correctly in the blanks; in some cases there may be several correct answers and any one correct answer is acceptable.

(a)

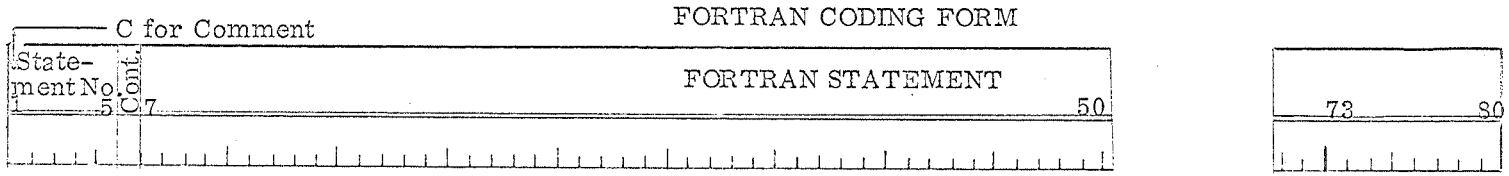
```
I = 0
GO TO (2, 6, 10, 55), I
```



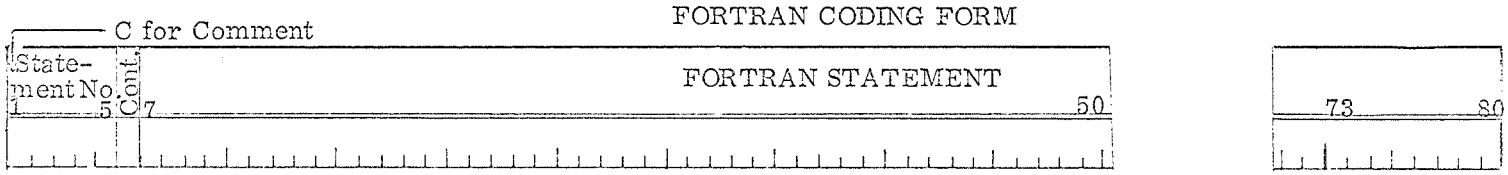
3. (Cont.) (b) GO TO, (10, 99, 3, 1), NUMBER



(c) ASSIGN 20 TO JSWCH
GO TO, JSWCH



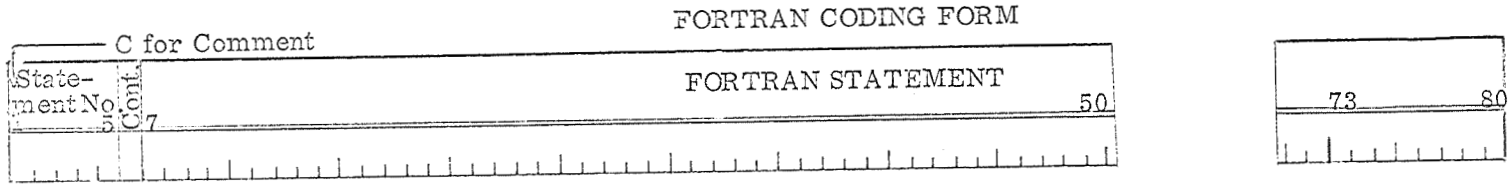
(d) I = 7
GO TO (3, 50, 2), I



Exercise III. B

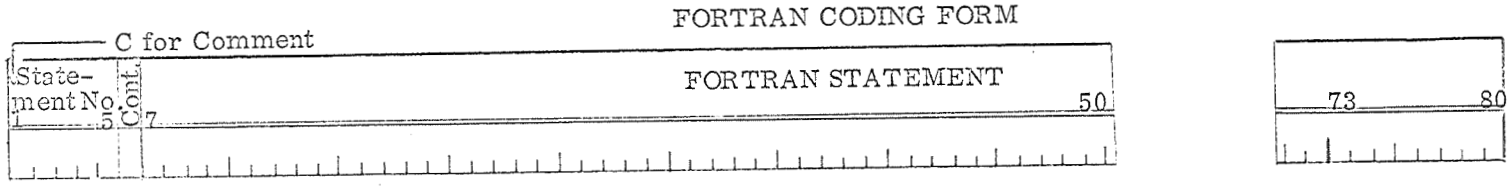
3. (Cont.) (e)

```
J = 100
GO TO (100, 150, 23), J
```



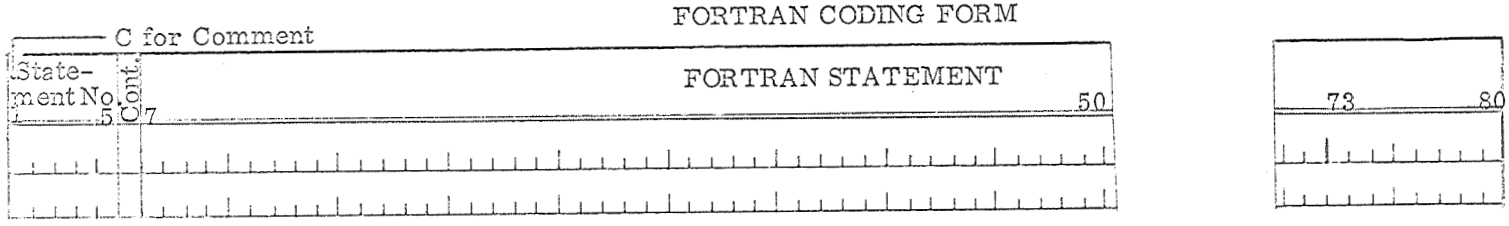
(f)

```
ASSIGN 50 TO ISWCH
GO TO ISWTCH
```



(g)

```
ASSIGN 10 TO B
GO TO B, (20, 30, 10)
```



4. In this problem you will see how the control variable in the computed GO TO can be any integer variable used in computations elsewhere in the program, as long as the programmer ensures that its value is suitable for use with the GO TO statement at the time it is used there.

For example, although the control variable in the computed GO TO must not have a value of zero, or no transfer will be made, you can make use of a variable whose value might be zero resulting from other calculations as long as you temporarily increment it during its use with the GO TO, and then reverse the process before continuing with the program.

For this problem, in the blanks here write your coding to complete the GO TO statement and to supply the other required statements. Given: the GO TO variable, J, has been used elsewhere in the program, and its value will be 0, 1 or 2 before statement 10.

a.) You are to set another variable, P, equal to some value, such that

If J = 0 then set P equal to 1.0

If J = 1 then set P equal to X

If J = 2 then set P equal to X^2

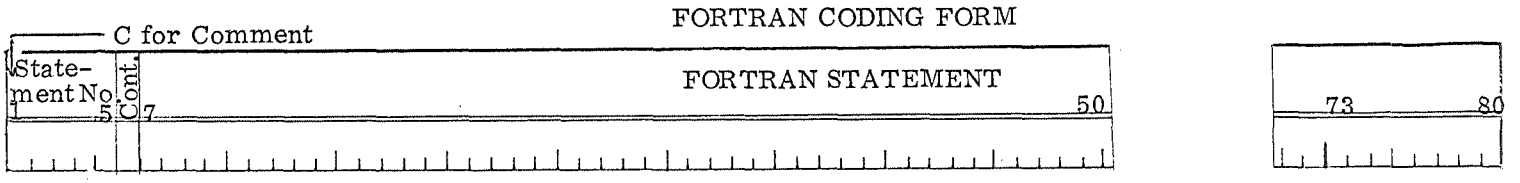
b.) After you have set P to the desired value, go on to the rest of the program.

```
10  J = J+1
    GO TO (          ), J
20  J = J-1
    (program continues)
```

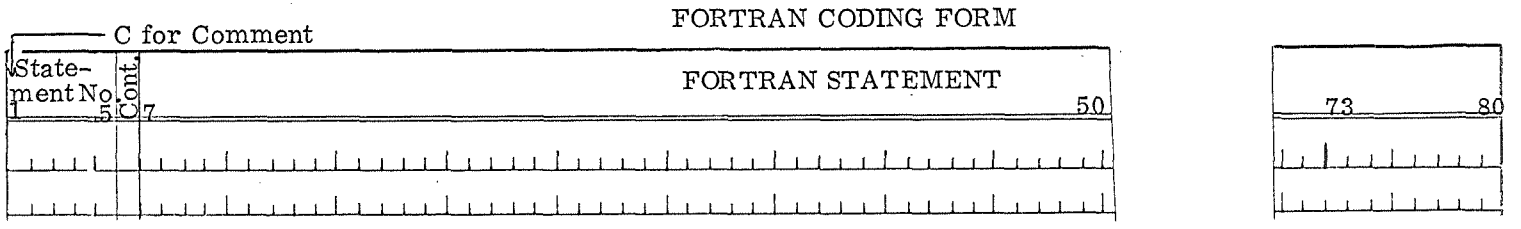
Exercise III.B

5. Write FORTRAN statements to do the following.

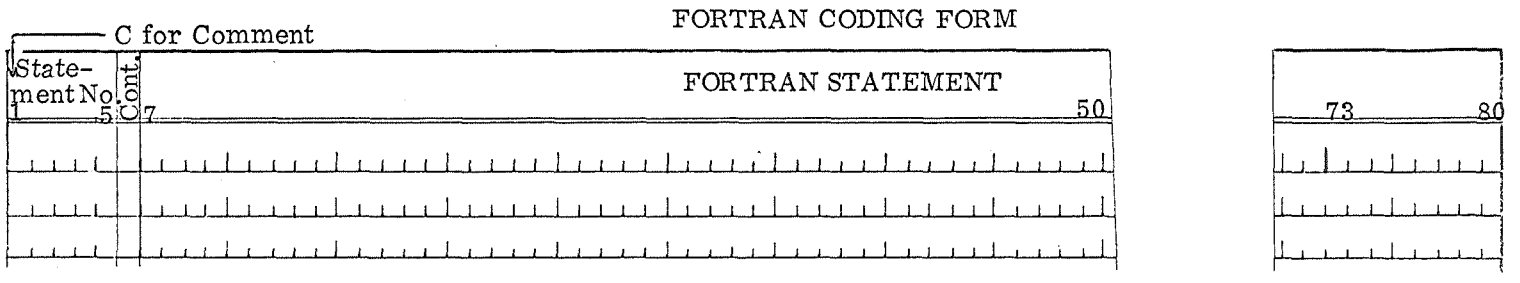
a.) Using the unconditional GO TO, send the computer to statement 50.



b.) Using the assigned GO TO, send the computer to statement 50.



c.) Using the computed GO TO, send the computer to statement 50. Choose your own method of those applicable for computing the value of the variable.



Exercise III. C

1. Write the FORTRAN expression which is equivalent to each of the following:

a.) Arithmetic variables: A is greater than B and less than C _____

b.) Arithmetic variables: A is greater than B and not greater than C _____

c.) Logical variables: A is the same as B and not the same as C _____

d.) Arithmetic variables: A is the same as B and not the same as C _____

e.) Arithmetic variables: either A is equal to B or C is equal to D _____

2. See II. E. 18 (Methods of Writing Octal Constants)

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80
		I = 14B	
		J = 24B	
		IX = I .AND. J	

The octal value in IX will be _____.

Exercise III. C

3.

C for Comment

FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		LOGICAL I, J	
		.	
		.	
		.	
		IX = I .AND. J	

The binary digits in IX will be either all _____ or all _____.

4. Look at the following program segment, and answer the questions below.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DIMENSION I(10)	
		LOGICAL I	
		INDEX=J	
20		GO TO (30, 40, 75), INDEX	
30		I(INDEX) = J .LT. K	
15		INDEX = INDEX + 1	
		GO TO 20	
40		I(INDEX) = L .EQ. M	
		GO TO 15	
75		(program continues)	

Indicate the true or false value of the logical variables assuming the statements above are executed with the values given below:

	J	K	L	M	I(INDEX) after statement 30	I(INDEX) after statement 40
a.)	1	2	3	4	_____	_____
b.)	1	1	6	6	_____	_____
c.)	2	1	3	4	//////////////	_____

Exercise III.D

1. There are three kinds of IF statements.

a.) The Three-Branch Arithmetic IF

The program branches to the first statement number listed in the IF statement if the value of the control expression is _____, to the second statement if the value is _____, and to the third statement if the value is _____.

b.) The Two-Branch Logical IF

The program branches to the first statement listed in the IF statement if the value of the control expression is _____, to the second statement if the value is _____.

c.) The One-Branch Logical IF

If the value of the control expression is _____, the program executes whatever statement is included with the IF; but, if the value is _____, the program ignores the optional statement with the IF, and goes to the next sequential statement.

2. Write the three-branch arithmetic IF statement that expresses each of the following:

a.) If I<1, go to statement 20; otherwise go to statement 30 _____

b.) If I≤1, go to statement 20; otherwise go to statement 30 _____

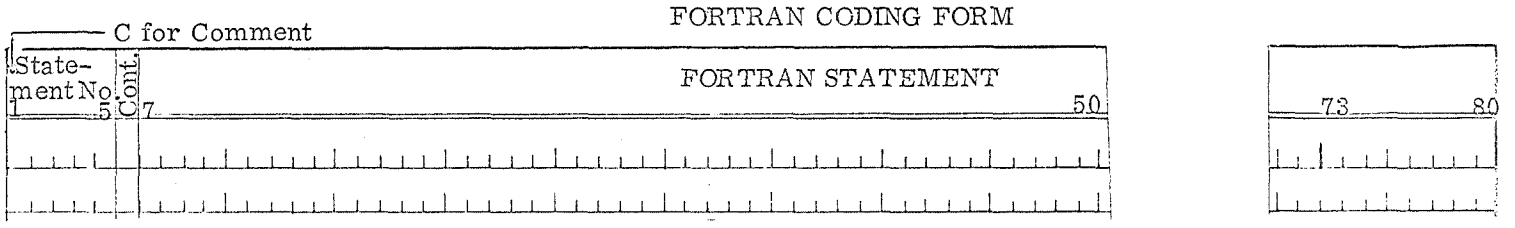
c.) If INDEX≥400, go to statement 40; otherwise go to statement 10 _____

d.) If A>B, go to statement 30; if they are both equal, go to statement 60; otherwise go to statement 25

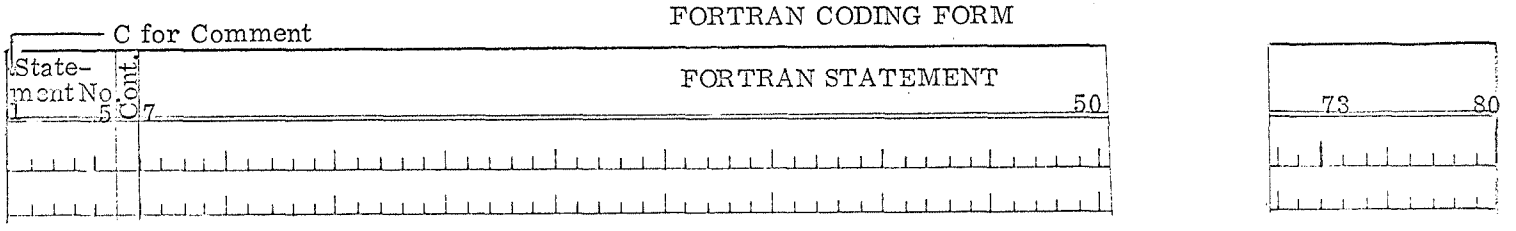
_____

3. For each of the following arithmetic expressions, write two statements: first, write a statement saving the result of the computation in a variable of the same mode as the expression (use N for integer variable, R for real variable); second, write a three-branch arithmetic IF statement that uses this new variable as the control expression, and carries out the instructions with each expression.

a.) $\frac{\text{JCOUNT} - 1}{2}$ If result is negative, go to statement 10; if result ≥ 0, go to 35.



b.) 8.(x + 10.) If result is negative, go to 30; if result = 0, go to 50; if result is positive, go to 40.



Exercise III. D

3. (Cont.) c.) 100 - MAX

If result is ≤ 0, go to statement 50; otherwise go to 100.

C for Comment

FORTRAN CODING FORM

Statement No. 1–5	Cont.	7–50 FORTRAN STATEMENT	73–80

d.) 100.-SUM

If result is negative, go to statement 20; if result is 0, go to 10; otherwise go to 35.

C for Comment

FORTRAN CODING FORM

Statement No. 1–5	Cont.	7–50 FORTRAN STATEMENT	73–80

e.) $bx^2 - 2.\frac{y}{az}$

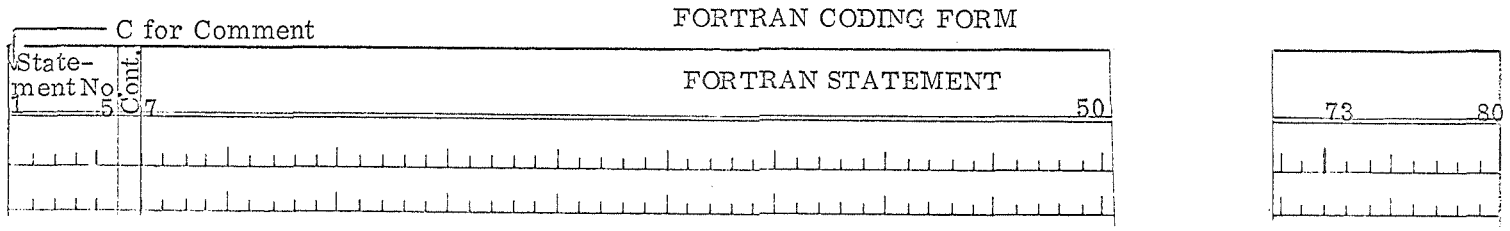
If result is negative, go to statement 55; otherwise go to 100.

C for Comment

FORTRAN CODING FORM

Statement No. 1–5	Cont.	7–50 FORTRAN STATEMENT	73–80

3. (Cont.) f.) $(mk)^2 - 2(i + k)$ If result = 0, go to statement 60; otherwise go to 70.



4. Three brothers, Art, Bob, and Charlie, have their ages recorded in variables A, B, and C, respectively. All ages are different. A wealthy uncle who does not know which brother is oldest or which is the youngest, has left money to Art, the amount of which depends on whether he is the oldest, the second oldest, or the youngest. Please help the lawyer find out how much money Art will get. (Use the arithmetic IF.) The amount will be put in the variable FORTUNE. Here is the plan:

(1) If Art is older than both Bob and Charlie (A is greater than both B and C), go to statement 50.

(2) If Art is younger than Bob but older than Charlie, go to statement 70.

(3) If Art is older than Bob but younger than Charlie, go to statement 70.

(4) If Art is younger than both Bob and Charlie, go to statement 100.

Write your program in the three blank lines of the coding form provided on the following page.

Exercise III.D

4. (Cont.)

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
50		FORTUNE=500000.00	
		GO TO 66	
70		FORTUNE=50000.00	
		GO TO 66	
100		FORTUNE=5000.0	
66		(program continues)	

5. Referring to the problem above about Art's inheritance, if Art is now at least 21.0 years of age, he will get the money right away; but if his age is less than 21.0 years, he must wait. Write a program to determine action to be taken. If Art's age is 21.0 or more, go to statement 10, but if his age is less than 21.0, go to statement 20.

Write your coding here:

FORTRAN CODING FORM

C for Comment

Statement No 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

6. Indicate which of the following two-branch logical IF statements is correct by + ; if incorrect, indicate by - and give reason.

a.) IF (A EQ B) 5, 10 _____ _____

b.) IF A .EQ. B 5, 10 _____ _____

c.) IF (A .EQ. B), 5, 10 _____ _____

d.) IF (A .EQ. B) 5, 10 _____ _____

Exercise III. D

7. Remembering the definition of a one-branch logical IF statement, after each example write + if it is a valid one-branch logical IF; but, if it is not valid, enter - and the reason why. Assume that TEST is a logical variable.

a.) IF (A .EQ. B) D = A

_____ _____

b.) IF (A = B) D = A

_____ _____

c.) IF (T .EQ. 90.0) A**2 + B**2 = C**2

_____ _____

d.) IF (X .GE. Y) GO TO 50

_____ _____

e.) IF (G .NE. H) INTEGER G, H

_____ _____

f.) IF (DATA .GE. 100.0.AND.DATA .LT. 101.0) TEST = .TRUE.

_____ _____

8. Using the one-branch logical IF statement, solve the following problem:

Suppose you wish the computer to perform some calculations several times, but--on the first iteration only--you wish to execute an additional step (in this case it will be: ISTART=1).

The computer must determine, at each iteration, whether or not this is the first iteration, and will skip the additional step if it determines this is not the first iteration.

To enable the computer to determine if it is in the first iteration, or in a second or later iteration, you will create an on-off switch, a logical variable we will call NOTFRST, and let the computer test the switch using the one-branch logical IF. When NOTFRST is true, or on, the computer knows this is not the first iteration.

Write statements that will do the following:

(a) Initialize NOTFRST to a false value (in other words, turn the switch off) before starting on the calculations for the first time. (Assume that NOTFRST has already been declared logical in a type statement.)

(b) Using the one-branch logical IF with NOTFRST as its logical control expression, tell the computer: If this is the first iteration, execute the statement ISTART=1, and then turn on NOTFRST (set it to true for all successive iterations). Next go on to statement 40, where the program continues.

(c) But if this is not the first iteration, merely go to statement 40.

Use the coding form provided on the following page.

Exercise III.D

8. (Cont.)

FORTRAN CODING FORM

C for Comment

1 Statement No 5	Cont.	7 FORTRAN STATEMENT 50	73 80

Exercise III. E

1. The FORTRAN statement that automatically sets up the repetitive loop is called a _____ statement, and the group of statements between this statement and the terminal statement is called a _____ loop.

2. The DO statement defines the initial value of its control variable; the amount by which this variable is to be _____ upon each repetition of the loop; and the _____ value of the variable, which determines whether to repeat the loop or to exit from it.

3. Indicate your choice of answers for each of the following questions (there is only one correct answer for each):

   (a) The index (control) variable in the DO statement is restricted to a: _____

      1.) Simple integer variable
      2.) Simple integer variable or integer expression

   (b) The three loop parameters--the initial value of the control variable, maximum value, and amount of the increment (if given)--may be: _____

      1.) Either integer constants or simple integer variables
      2.) Only simple integer variables

   (c) Which of the following is true about the loop parameters? _____

      1.) If one parameter is a variable, all must be variables; if one is a constant, all must be constants.
      2.) It is valid to mix them; that is, one may be a constant, one a simple integer variable, etc.

Exercise III. E

3. (Cont.) (d) If a loop parameter is a constant, it _____

1.) Must be positive and non-zero
2.) May be negative, or positive, or zero

(e) Which of the following is a valid DO statement? _____

1.) DO 20 INDEX = 1, 10
2.) DO 20 CONTROL = 1, 10

(f) Which of the following is a valid DO statement? _____

1.) DO 3 I=2, MAX
2.) DO 3 I=2, XMAX

(g) Which of the following is a valid DO statement? _____

1.) DO 10 J=2, 1
2.) DO 10 J=2, 0

4. The following DO statements each represent the beginning of a different DO loop. How many times will each loop be executed?

a.) DO 20 I=1, 10 _____

b.) DO 35 J=2, 1 _____

c.) DO 200 INDEX=1, MAX _____

d.) DO 99 M=5, 35, 5 _____

e.)
```
I=1
J=I+1
MAX=J+1
DO 300 INDEX=J, MAX
```

f.) DO 19 N=1, 20, 3 _____

5. The value in the second parameter of the DO statement can be changed outside of the DO loop. Which of the following DO statements can have this value changed? _____

1.) DO 20 NUM=1, 20
2.) DO 20 NUM=1, MAX

Exercise III. E

6. The statement at the end of the DO loop, the terminal statement, must be an executable statement, with certain qualifications. Following are two lists of statements: one contains all valid terminal statements, the other contains all invalid terminal statements. For each list, write the word valid or invalid at the head of the list.

a.) _____ terminal statements for DO loops:

1.) FORMAT
2.) DIMENSION
3.) COMMON
4.) type declaration
5.) statement without a statement number
6.) PAUSE
7.) STOP
8.) END
9.) RETURN
10.) arithmetic IF statement
11.) another DO statement
12.) a GO TO statement

b.) _____ terminal statements for DO loops:

1.) Numbered statement (provided it also fits one of the following categories)
2.) Any arithmetic expression
3.) the CONTINUE statement
4.) logical IF statement (to be used, however, with extreme caution)

7. Determine if each of the following statements can be the terminal statement in a DO loop. Answer yes or no for each:

a.) 50 IF (A) 10, 20, 30 _____

b.) 50 A = B _____

c.) 50 CONTINUE _____

d.) 50 DIMENSION ARRAY (5, 5) _____

e.) 50 LOGICAL FLIP _____

f.) 50 GO TO (10, 20, 30), I _____

g.) 50 IF (I) 10, 20, 30 _____

h.) 50 A = R + S*SIN (2.*3.1416) _____

i.) 50 IF (A.AND.B) C = 2.0 _____

j.) 50 DO 10 I = 1, 6 _____

Exercise III.E

8. Some of the statements in the following DO loop contain coding errors. (For your convenience in referring to the incorrect statements, all statements have been given statement numbers, although this is not necessary in actual practice.)

C for Comment

FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)
1		DIMENSION VALUE(100)
10		DO I 5 = 1, 99
2		J = I + 1
3		IF VALUE(1) .LESS. VALUE(J)) 5, 6
6		X = VALUE(1)
7		VALUE(1) = VALUE(J)
8		VALUES (J) = X
5		GO TO 10
		(program continues)

73 80

8. (Cont.) For each incorrect statement, list its statement number, and write a correct version of the statement.

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

Exercise III. E

9. Rewrite this routine (which uses an IF statement) to one that uses a DO loop to accomplish the same purpose. This example sets the values of a 400-place array called INDEX to a series of ascending numbers, with INDEX(1) being set to 1, INDEX(2) being set to 2, and so on up to INDEX(400) being set to 400.

```
      DIMENSION INDEX (400)
      I = 0
   10 I = I + 1
      INDEX(I) = I
      IF (I - 400) 10, 30, 30
   30 (rest of program)
```

Write your DO loop below:

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)

Exercise III. E

10. Write a routine, using a DO loop and any other desired statements, that will do the following:

a.) Define an array called ISUM having one dimension of 30 values.

b.) Compute the sum of the values in the first 29 locations of ISUM, accumulating the total in the 30th location of ISUM.

c.) If the total in ISUM(30) is 100 or more, place this total in a variable named LARGE; but, if the total in ISUM(30) is less than 100, place the total in a variable named LITTLE.

d.) Then go on to the rest of the program.

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	7–50 FORTRAN STATEMENT	73–80

Exercise III. E

11. Write a routine on the form below, using a DO loop, to perform the following: in the DO loop multiply the variable SUM by 2.0, either MAX times (the loop parameter), or until SUM $\geq$ the variable VALUE.

(SUM and VALUE hold floating-point values previously defined elsewhere. MAX, the loop parameter for maximum number of repetitions, has also been defined elsewhere. You may define your other loop parameters as you wish. Obviously, if SUM $\geq$ VALUE before the loop is repeated MAX times, you will be utilizing the device of the "special exit" from the loop (that is, without satisfying the loop parameters).)

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	7–50 FORTRAN STATEMENT	73–80

12. Write a program using a nested DO loop. Sort any five positive integer numbers that are now in random order in an array called MIXED. (There are no duplicate numbers.) Place the lowest number in MIXED(1), the next lowest in MIXED(2), and so on. You will recall that you can do this in just 8 statements following the DIMENSION statement, which is written here to start your program.

C for Comment

FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)
		DIMENSION MIXED(5)

73–80

Exercise III. E

13. Write a program to do the following:

a.) Define three arrays of one-dimension, 1000 locations each, to be called MAP, IPOS, and INEG. (MAP will already contain 1000 random values that may be positive, negative, or zero. IPOS is an array into which the program will store successive positive values as they are encountered in MAP, and INEG is likewise an array for negative values from MAP.)

b.) Initialize (set to zero) the five accumulator variables:

1.) IZERO (this will be used to tally up the total number of zero values)

2.) IPOSM (this will be used to hold a cumulative sum of all positive values in MAP)

3.) INEGM (this will be used to hold a cumulative sum of all negative values in MAP)

4.) Another integer variable (you name it) to be used for subscripting IPOS and as a counter for adding positive values in IPOSM

5.) Another integer variable (you name it) to be used for subscripting INEG and as a counter for adding negative values in INEGM

c.) Write a DO loop to evaluate all 1000 locations in the array MAP to see if they are negative, zero, or positive values. If the value from MAP is zero, add 1 to the zero-value counter IZERO; if the value from MAP is positive, place it in the next sequential location in the positive-value array IPOS; and if the value from MAP is negative, place it in the next sequential location in the negative-value array INEG. In the same loop develop a cumulative sum of the positive values in IPOSM and a cumulative sum of the negative values in INEGM.

Exercise III. E

13. (Cont.)

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

Exercise III. E

13. (Cont.)

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

Exercise IV.C

1. What is the purpose of the list in an I/O statement?

_____

2. How is one item of an I/O list separated from another in the list?

_____

3. What is the maximum allowable length for a list?

_____

4. May a list item be subscripted? _____

Let us now look at some I/O lists as they might appear in a program. Consider the following five lines of code, and assume that formats 10, 20, 30 and 40 are available:

```
(1)   DIMENSION A(10), B(5, 2), C(3, 3, 3), I(6), J(4, 4)
(2)   READ 10, (A (IX), B(IX,1), IX = 1, 5)
(3)   READ 20, I, (B (IX, 2), IX = 1, 5)
(4)   READ 30, C
(5)   READ 40, J(1, 1), J(2, 1), J(3, 1), J(4, 1)
```

5. What is the list of line (2)?

_____

6. What is the list of line (4)?

_____

7. How many items will be read at line (2)?

_____

Exercise IV. C (Continued)

8. Write the items in the order in which they will be read. (line 2)

_____

9. How many items will be read at line (3)?

_____

10. Write the items in the order in which they will be read. (line 3)

_____

11. How many items will be read at line (4)?

_____

12. Write in order the first six items read in at (4).

_____

13. How many items will be read at line (5)?

_____

14. Write the list from line (5) as an implied DO loop. _____

Now consider some other lists:

```
(1)   PRINT 7, I, X(I),
(2)   PUNCH 999, CAT DOG MOUSE
(3)   PRINT 5000, A, B(K), K = 4, 10
(4)   PRINT 1776, DATE, TIME, (RESULT (I), I = M, N)
```

15. What fault can you find with the list in line (1)?

_____

16. What fault can you find with the list in line (2)?

_____

17. Is there a fault in the list in line (3)?

_____

18. If answer to 17 is "yes", what is it?

_____

19. Is there a fault in the list in line (4), and if so, what is it?

_____

20. Insert missing parentheses in the proper places in the following list:

```
READ 100, ARRAY(I, J, K), I = 1, IMAX, J = 1, JMAX, K = 1, KMAX
```

Exercise IV.D

1. What kind of FORTRAN statement tells what data conversion(s) is(are) to be used for an I/O list?

_____

2. By what means does an I/O statement refer to a particular FORMAT statement?

_____

3. May more than one I/O statement refer to a single FORMAT statement?

_____

4. May one I/O statement refer to more than one FORMAT statement?

_____

5. Where does the FORMAT statement number appear on the coding form or punched card?

_____

6. Where do the letters FORMAT appear?

_____

7. Where may the FORMAT statement appear in the program?

_____

8. Do you know why there are so few restrictions on the placement of FORMAT statements within a program? _____

If you answered yes, proceed to question 9. If you answered no: a FORMAT statement is not "executable"; that is, it does not generate any code within the part of the program which the computer is to execute.

Exercise IV.D (Continued)

9. May a FORMAT statement extend to more than one line of coding?

_____

10. How many FORMAT statements may appear within a program?

_____

11. How do you think you are going to like programming?

_____

Exercise IV.E

1. For what kind of number is the Ew.d conversion used?

_____

2. What does w indicate?

_____

3. What does d indicate?

_____

4. What is the rule-of-thumb relationship between the sizes of w and d?

_____

Suppose five variables contain quantities as follows:

Variable	Value
A	3.14159260
B	5280.0
C	57.29577950
D	.017453290
E	6378.3880

Write the output values for the following lists and formats, using b to indicate a single blank.

5.
```
    PRINT 100, A, B, C, D, E
100 FORMAT (E12.5, E12.3, E6, E12.3, E10.3)
```

_____

6.

```
    PRINT 555, A, E
555 FORMAT (E10, E10)
```

_____

7.

```
    PRINT 123, B
123 FORMAT (E9.2)
```

_____

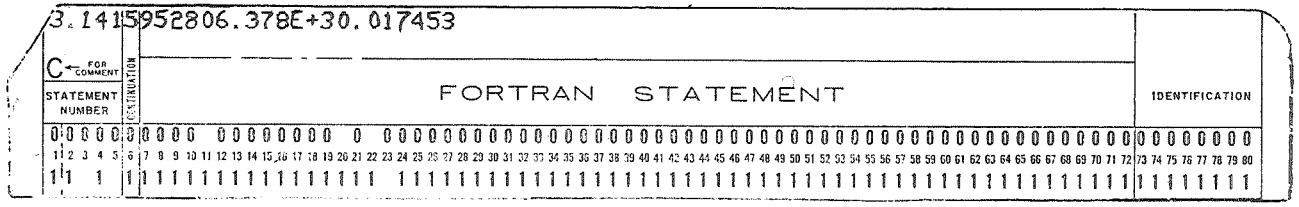
8.

```
  PRINT 1, D, C
1 FORMAT (E13.6, E12.3)
```

_____

Exercise IV. F

An input data card is punched



1. What values will be read by

```
    READ 10, A, B, C, D
10  FORMAT (E4.2, E7.4, E9.3, E7.2)
```

_____

2. What values will be read by

```
     READ 9999, W, X, Y, Z
9999 FORMAT (E7.3, E4.0, E8.3, E8.6)
```

_____

3. What values will be read by

```
     READ 500, PI, RAD, DTR
500  FORMAT (E12.10, E8.3, E7.5)
```

_____

1. For what type of number is Fw.d conversion used?

_____

2. What does w indicate?

_____

3. What does d indicate?

_____

4. Is it permissable for d to be zero?

_____

5. What effect does d=0 have on output?

_____

6. Is a sign output under Fw.d conversion?

_____

Consider again the five variables:

Variable	Value
A	3.14159260
B	5280.0
C	57.29577950
D	.017453290
E	638.3880

Write the output values for the following lists and formats, using b to indicate a single blank.

Exercise IV.G (Continued)

7.

```
      PRINT 123, D, E, B
123   FORMAT (F10.4, F10.4, F10.4)
```

_____

8.

```
      PRINT 19, A, C, E
19    FORMAT (F4.2, F12.7, F4.0)
```

_____

9.

```
      PRINT 1111, D
1111  FORMAT (F10.6)
```

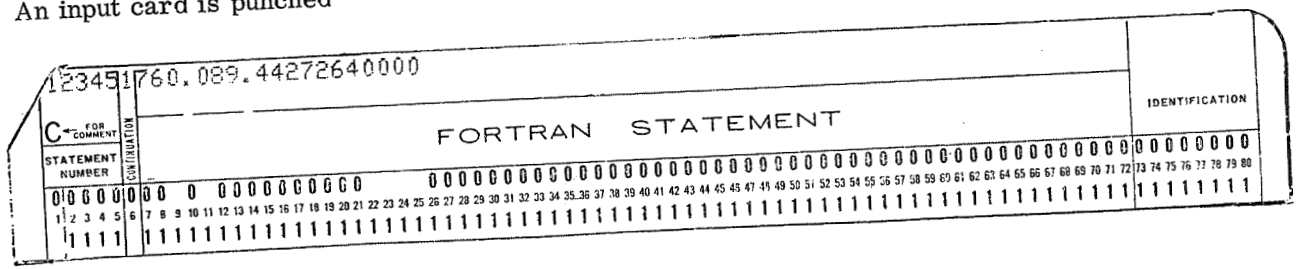
_____

10.

```
      PRINT 2, A, B, C, D, E
2     FORMAT (F2.0, F5.0, F3.0, F4.0, F4.0)
```

_____

An input card is punched



1. What values will be read for

```
    READ 10, VAL, YDS, SQT, SQ
 10 FORMAT (F5.2, F6.1, F8.5, F6.0)
```

_____

2. What values will be read for

```
    READ 98, A, B, C
 98 FORMAT (F7.2, F5.2, F13.11)
```

_____

3. What values will be read for

```
    READ 500, ONE, TWO
500 FORMAT (F10.4, F10.6)
```

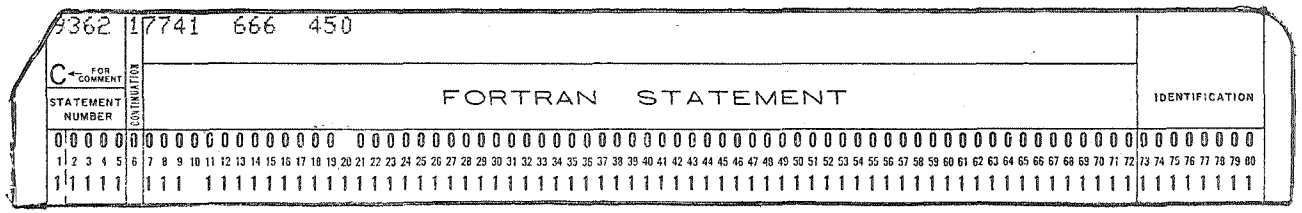
_____

Exercise IV.I

1. For what type of number is Iw conversion used?

_____

An input card is punched



2. What values will be read for

```
    READ 100, I, J, K, L
100 FORMAT (I4, I6, I5, I5)
```

_____

3. What values will be read by

```
    READ 101, N1, N2, N3
101 FORMAT (I5, I3, I3)
```

_____

4. What values will be read by

```
    READ 102, MA, MB, MC
102 FORMAT (I6, I3, I5)
```

_____

In core these values are stored:

Variable	Value
IMP	12345
JOB	67890
KEY	1440
MOP	365
NAP	1

5. What will be output for

```
      PRINT 1, NAP, KEY, IMP
    1 FORMAT (I5, I5, I5)
```

_____

6. What will be output for

```
      PRINT 2, KEY, KEY, KEY
    2 FORMAT (I7, I6, I5)
```

_____

7. What will be output for

```
      PRINT 3, IMP, JOB
    3 FORMAT (I8, I5)
```

_____

8. What will be output for

```
      PRINT 4, IMP, MOP, NAP, KEY, JOB
    4 FORMAT (I7, I4, I2, I5, I6)
```

_____

Exercise IV.J

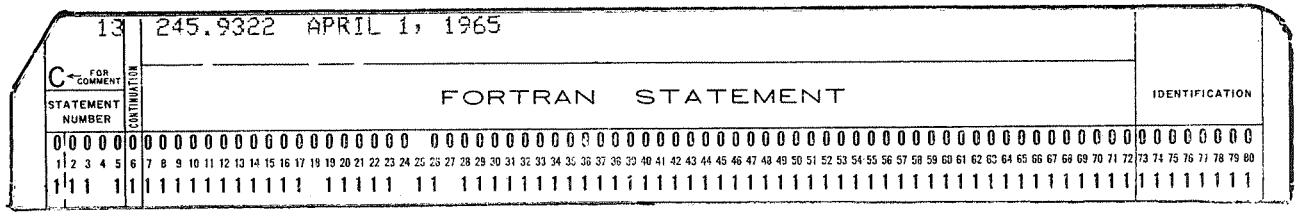
1. For what purpose is the wX specification used during input?

_____

2. For what purpose is the wX specification used during printing?

_____

3. An input card is punched



3. What values will be read in by

```
      READ 555, IX, VAL
  555 FORMAT (I5, 2X, F8.4)
```

_____

4. What values would be read in by

```
      READ 8722, K, X, IYEAR
 8722 FORMAT (I6, F9.4, 11XI4)
```

_____

5. What values would be read in by

```
    READ 10, V1, I1
10  FORMAT (11XF4.2, 7XI2)
```

_____

In core are the following values:

IDAY	=	2
IYEAR	=	1967
VAL(1)	=	10.0
VAL(2)	=	20.0
VAL(3)	=	30.0
IWEEK	=	34
	=	

6. How would the output look for

```
    PRINT 100, IWEEK, IDAY, IYEAR
100 FORMAT (10X, *WEEK*I3, 2X, I2, *NDbDAY*, 2X, *YEAR*, I5)
      .
      .
      .
    PRINT 102, (VAL(I), I = 1, 3)
102 FORMAT (2XF4.1, 2XF4.1, 4XF4.1)
```

_____

_____

_____

Exercise IV.K

1. What character, when used in a FORMAT statement, indicates the end of a record?

_____

2. How many cards will be read by

```
    READ 472, AG, BA, CF, DM, EU
472 FORMAT (3XF4.4/E10.2, E10.4//F15.5, E12.4)
```

_____

3. How many lines will be produced by

```
    PRINT 1, (ARRAY(I), I = 1, 4), K1, K2
  1 FORMAT (//2XF5.1, 2XF5.1, 2XF5.1, 2XF5.1//I10/I10)
```

_____

4. How many lines will be produced by

```
    PRINT 88, I, J, K
 88 FORMAT (///10X, I3, 2XI4, 2XI5)
```

_____

5. How many lines will be produced by

```
    PRINT 888, I, J, K
888 FORMAT (///10X, I3, 2X, I4, 2XI5/)
```

_____

6. How many lines will be produced by

```
      PRINT 8888, I, J, K
 8888 FORMAT (//10X, I3, 2X, I4, 2X, I5//)
```

_____

7. Of the five lines produced by

```
      PRINT 16, I, M, A
   16 FORMAT (//I10/I10/2XE20.9)
```

the first line will be (blank, printed), the second line will be (blank, printed), the third line will be (blank, printed), the fourth line will be (blank, printed), the fifth line will be (blank, printed).

Exercise IV. L

1. For what kind of data is the wH specification used? _____

2. For output purposes, the wH characters to be output appear within the_____statement itself.

3. On input, the wH characters to be_____are read into a particular FORMAT statement.

4. Blanks appearing within a wH specification field are ignored. True or false? _____

5. FORTRAN characters appearing in a wH specification field are converted to CDC 6000 series _____ _____ _____.

Consider the following coding:

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)
100		FORMAT(30H I5)
		DIMENSION ARRAY(6)
		DO 1 I=1,2
		READ 100, KIND
		READ 101, N, (ARRAY(NN), NN=1,N)
101		FORMAT(I5,6F10.1)
		PRINT 100
		PRINT 102, (ARRAY(NN), NN=1,N)
102		FORMAT(7F10.1)
		GO TO (2,3), KIND
2		...
		...
		...
		GO TO 1
3		...
		...
		...
1		CONTINUE

73 80

Exercise IV. L (Continued)

The four cards to be read are as follows:

```
INPUT COMPONENTS - TYPE 1          2
C ← FOR COMMENT | CONTINUATION | FORTRAN STATEMENT | IDENTIFICATION
STATEMENT NUMBER
```

```
3        122.6      147.2      826.9
C ← FOR COMMENT | CONTINUATION | FORTRAN STATEMENT | IDENTIFICATION
STATEMENT NUMBER
```

```
LATITUDE AND LONGITUDE --          1
C ← FOR COMMENT | CONTINUATION | FORTRAN STATEMENT | IDENTIFICATION
STATEMENT NUMBER
```

```
2        -22.6      133.0
C ← FOR COMMENT | CONTINUATION | FORTRAN STATEMENT | IDENTIFICATION
STATEMENT NUMBER
```

6. What would the output be from the above coding?

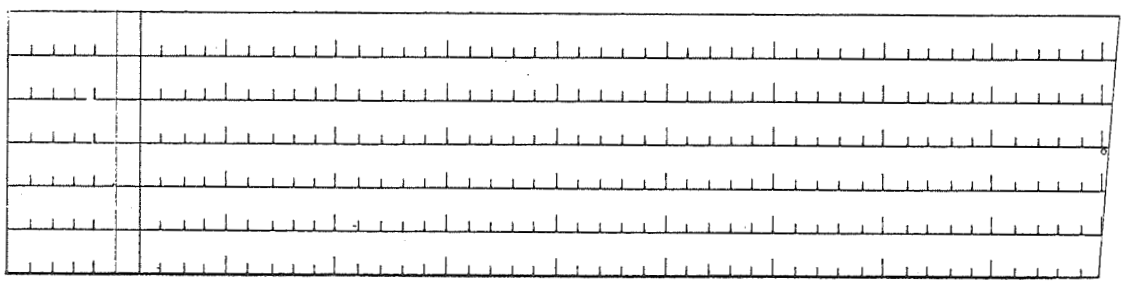
_____

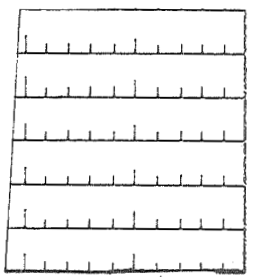
_____

_____

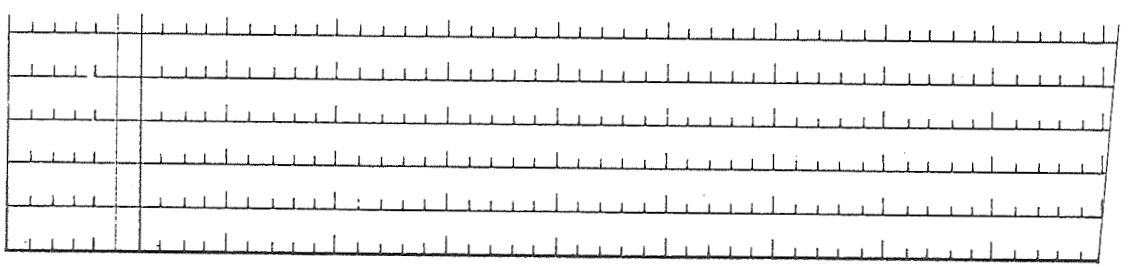
_____

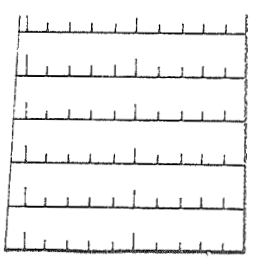
7. Write the necessary statements to zeroize an array VALUE whose size is 5.





8. Write the necessary statements to print the message I LIKE FORTRAN.





Exercise V.A

1. Consider the following statement function.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		STFNXY(X,Y)=X**2+24.0*X*Y	

a.) The name of this statement function is _____.

b.) The formal parameters are _____ and _____.

c.) The function to be evaluated is _____.

d.) This statement must _____ (precede, follow) all executable statements in the program.

2. Consider the following statement and assume that it appears later in the same program as the statement function in problem 1.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		Z=STFNXY(A,B)	

a.) The values A and B are the _____ parameters in this reference to the statement function STFNXY.

b.) If A = 1.0 and B = .5, the value of Z would become _____.

3. The formal parameters of a statement function are limited to simple variables and most of our examples have shown the actual parameters as simple variables. An actual parameter may be <u>any</u> arithmetic expression.

An example is the statement function

```
AREA(RSQ) = 3.14159265*RSQ
```

This function computes the area of a circle when given the square of the radius. Now suppose we know the coordinates of the center of a circle (p, q) and a point on the circle (x, y). The area Z can be obtained in two ways. One way is to compute the square of the radius and then refer to the function to get the area.

```
RSQD = (X - P)**2 + (Y - Q)**2
   Z = AREA (RSQD)
```

The second is to write the argument as an arithmetic expression.

```
Z = AREA ( (X - P)**2 + (Y - Q)**2)
```

In this case, the arithmetic expression is evaluated and the result is used as the argument.

Library functions are provided to compute many trigonometric and logarithmic functions. Two library functions are ALOG(p_1) and SQRT(p_1). These functions will compute the natural logarithm of a real variable and the square root of a real variable respectively. Using these two functions, write a statement function to compute HSININV(X) where HSININV(X) is the inverse hyperbolic sine of X. The arithmetic formula is

$$\sinh^{-1}(x) = \log_e \left(x + \sqrt{x^2 + 1}\right)$$

4. At this point, you are going to write a computer program using FORTRAN. It will be a simple program and you will be given step by step directions on its development.

Before starting to write a program, make sure you know what data variables you will input into the computer. Also, know what calculations are to be performed on these variables and what computed results are required.

The program we are going to write will assume that a simple harmonic transverse wave is traveling along a string of beads. Our job is to calculate the displacement of a particular bead at a particular time. The equation of the displacement is

$$y = a \text{ sine} \left[2\pi \left(\frac{t}{T} - \frac{x}{\lambda} \right) \right]$$

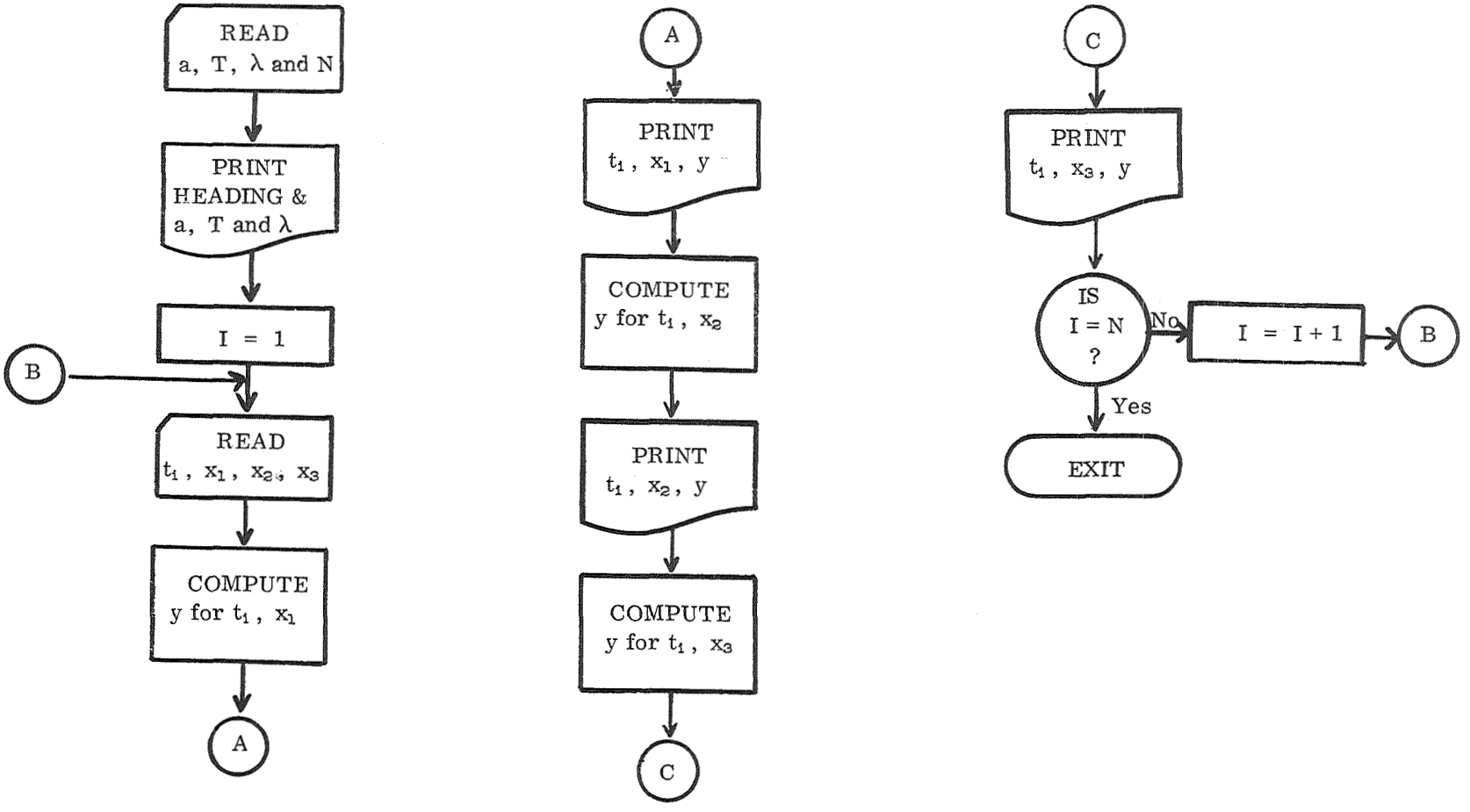
where

a = amplitude
t = time
T = period
x = distance of bead from origin
λ = wave length

The input required for the calculation is five parameters a, t, T, x, and λ. For our purposes, we will assume that a, T and λ will remain constant during a complete computer run. A sixth parameter, N, will be read which gives the number of different values of t which will be used. We will assume that three values of x will be input for each value of t.

The output will consist of a line of print for each computation. This line of print will consist of t, x, and y.

4.(Cont.) Once the problem is defined, a flowchart will usually make the coding easier.



Exercise V.A (Continued)

4. (Cont.) You are now ready to write your computer program. Assume that $SIN(p_1)$ is a function which will compute the sine of a real variable.

Step 1: Write a statement function to compute y. Since a, T, λ and t_1 appear in all three computations, the only parameter needed is x.

Step 2: Read the values of a, T, λ and N from the first input card. Be sure to use the same names which you used in the statement function. a, T and λ should be real. N should be integer.

Step 3: Write the format statement corresponding to the read statement in Step 2.

Step 4: Write statements which will (1) start a new page, print and identify the values, a, T and λ, and (2) make headings for the columns t, x, and y.

Step 5: Write a statement which will set I = 1.

Step 6: Write a statement to input the next card. This card contains the next value of t and the three values of x to be used in computing y. Be sure that you used the same variable name for t as you used in the statement function. Also write the necessary format statement.

Step 7: Use the first value of x in the statement function to obtain the corresponding value of y.

Step 8: Print the three values t, x_1, and y under the heading you printed earlier.

4. (Cont.)

Step 9: Use the second value of x in the statement function to obtain the corresponding value of y.

Step 10: Print the three values t, x_2, and y.

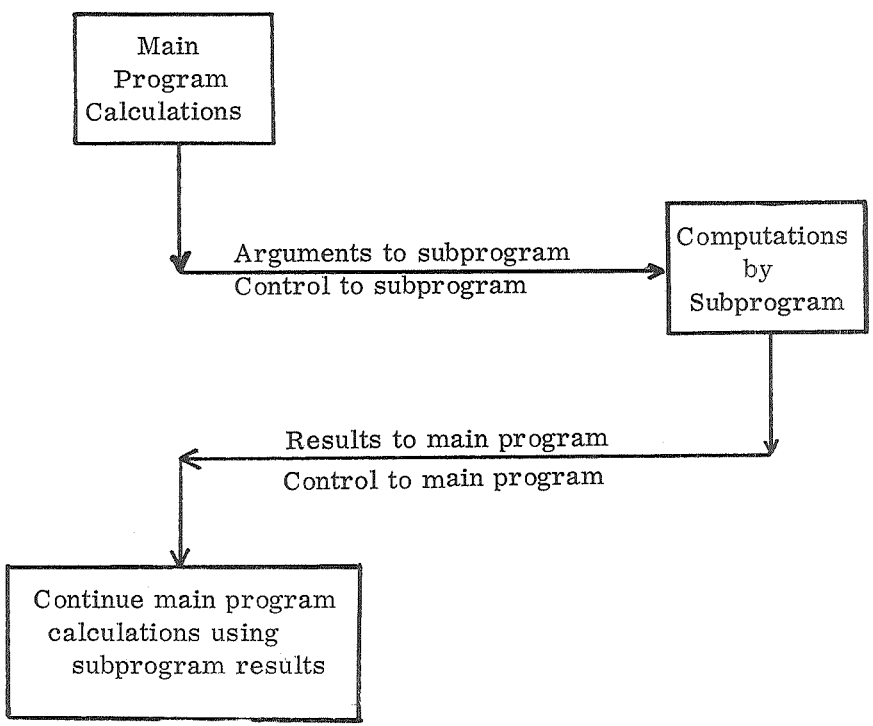
Step 11: Use the third value of x in the statement function to obtain the corresponding value of y.

Step 12: Print the three values t, x_3, and y.

Step 13: Test to see if I = N. If yes, write the statement CALL EXIT. If not, set I = I + 1 and then go to the statement which reads the next card containing a new value of t and three new x values.

Exercise V.B

1. Illustration of flow at execution time.



2. Since a subprogram is written as a separate entity, the number of arguments and their types is established at the time the subprogram is written. Any program which uses this subprogram must supply the _____ number of arguments and make sure that their _____ are as required by the subprogram.

3. The type of the result(s) from a subprogram is also determined at the time the subprogram is written. If a subprogram returns a real result, the main program must treat the result as _____.

Exercise V.C

1. Write a function subprogram which has three formal parameters A, B and N. The function is to return the sum of the first N products to A(1)*B(1) + A(2)* B(2) + ··· + A(N)*B(N) .

   Step 1: Write the function definition statement.

   Step 2: Make 1000 the maximum dimensions of A and B.

   Step 3: Set the sum to zero.

   Step 4: Set up a DO loop using the parameter N as the upper limit.

   Step 5: Sum all products.

   Step 6: Return to main program.

   Step 7: END

2. Write the first card (function definition statement) of a function which will return a complex result. The function is to have two parameters, B and C. The name of the function is CPROD.

*3. Suppose the function defined in problem 2 is being referenced by another program or subprogram which we shall call the main program. Write the statement which must appear in the main program to insure type compatibility.

*4. If a function has four formal parameters, any reference to the function must have _____ actual parameters.

*5. If the third formal parameter in a function is integer, the third actual parameter in a reference to the function must be _____.

*6. If the second formal parameter is dimensioned in a function, the second _____ _____ in a reference to the function generally should have the same dimensions.

*NOTE: Failure to comply with these items will not give a diagnostic message.

Exercise V.D

1. Write a subroutine subprogram having one parameter K. In the subroutine, K is to be tested for a value of 0, and if K does equal zero, the message "K = 0" is to be printed from instructions within the subroutine.

2. Write the statement which refers to the above subroutine in the main program.

3. Assume that in a main program the array LIST is dimensioned for a maximum of 50 values. Write a subroutine which searches the entire array, finds the smallest value, and places that value in LEAST.

Exercise V.E

1. If I = -3 and J = -5 , what values will be stored in K after execution of each of the following statements?

   a.) K = IABS(I)-IABS(J) _____
   b.) K = IABS(J)**2 _____
   c.) K = -IABS(I) _____

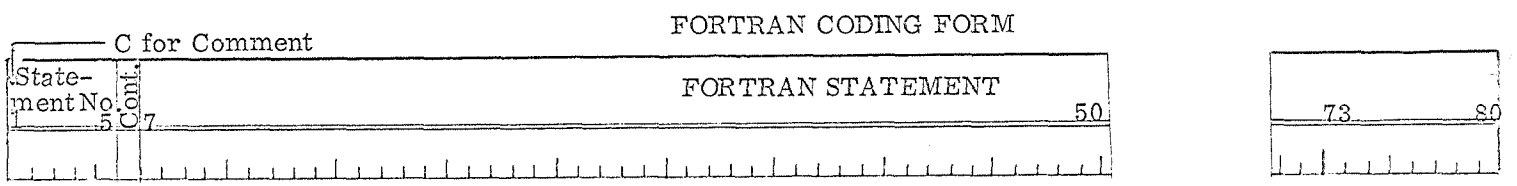
2. The statement X = AMIN1(A, B, C)+AMAX1(Y, Z) will cause the evaluation of _____ in-line functions with each function forming a term in the sum to be stored at location _____. The first term (function) will find the _____ value of the variables A, B, C, while the second term (function) will choose the maximum value from the variables _____ and _____.

3. Evaluate each of the following to determine what will be contained in location X after execution. (Assume I = 1, J = -5, K = 2, A = 2.5, B = 3.0, C = 5.0, D = -2.)

   a.) X = AMAX0(I, J, K) _____
   b.) X = AMIN0(I, J, K) _____
   c.) X = AMAX1(A, B, C)+AMIN1(B, C, D) _____
   d.) X = MAX0(I, J) **2 _____
   e.) X = MAX1(A, C) - MAX1(C, D) _____
   f.) X = ABS(AMIN1(A, B, C, D)) _____

Exercise V.E (Continued)

4. ALPHA is an angle of rotation computed and stored in degrees. Although ALPHA can represent the effect of many revolutions, only values between 0° and 360° are meaningful in a particular analysis. Write a statement using modular arithmetic which will disregard previous revolutions and store the angular distance traveled by ALPHA in its current revolution into a location called BETA.



5. The variable I is assigned the value 35. The statement N = MOD(I, 7) is then executed. N will be assigned the value _____.

6. If the variables P and Q are both declared COMPLEX with Q = 5.2 + 3.3i, which of the following statements would assign P the value 5.2 - 3.3i? _____

a.) P = AIMAG(Q)
b.) P = REAL(Q)
c.) P = CONJG(Q)

7. After executing the following sequence of instructions, what will be the values stored in locations A and B?

```
COMPLEX R, S
P = 3.7
Q = -5.5
R = CMPLX(P, Q)
S = CONJG(R)
A = REAL(S)
B = AIMAG(S)
```

_____

8. Before using any of the trigonometric library functions, one should guarantee that all angular arguments which exist in degrees have been converted to _____.

9. Write a sequence of statements to satisfy each of the following conditions:

a.) assign the tangent of X (in radians) to the variable Y
b.) assign the absolute value of the difference between the cosine of X (in radians) and the sine of X (in radians) to the variable Z
c.) assign the natural logarithm of X to the variable Y
d.) assign the sum of the square root of X plus the square root of Y to the variable Z
e.) assign the arctangent of the quotient A/B to the variable Y.

a.)
b.)
c.)
d.)
e.)

Exercise V. E (Continued)

10. Determine the value stored in location Z after execution of each of the following: (Assume X = 0.0, Y = 4.0.)

a.) Z = SIN(X)
b.) Z = COS(X*Y)
c.) Z = TAN(X)+COS(X)-SQRT(Y)
d.) Z = EXP(X)
e.) Z = SQRT(X**2+Y**2)

Exercise V. F

1. The difference between blank common and labeled common is that labeled common _____ _____.

2. An error exists in the following two statements. What is it?

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		COMMON /CEMENT/H2O, DRY	
		...	
		...	
		...	
		CALL CEMENT	

Exercise V.G

1. No computations are permitted in a BLOCK DATA subprogram. Are computations permitted in the main program?

2. Write a BLOCK DATA subprogram which a.) assigns the following 10 constants to data array SLEEP: 1.5, 2.0, 10.9, 5.7 three times, and 9.8 four times; b.) assigns the value 8.5 to variable HRS. Use one DATA statement, and ZZ as the block name.

Exercise V.H

1. In FORTRAN, alternate names can be assigned to variables by using the _____ statement.

2. Write a statement that allows the three simple variables: A, B, I to share the same storage location.

_____

3. Write a set of statements that dimensions an array named "C" at 10 and defines F as an alternate name of C(5).

_____

_____

4. Suppose F in the previous problem had been dimensioned at 3 and above statements applied. F(2) would share a storage location with C(__) and F(3) would share a storage location with C(__).

5. Suppose X is complex. Write an EQUIVALENCE declaration allowing the imaginary part of X to be referred to by the name UNREAL. Use the array F defined above.

_____

Exercise V.H (Continued)

6. Given:

```
COMMON/C1/A, B
COMMON/C2/C, D
DIMENSION E(2), F(3)
```

What is wrong with each of the following:

a. EQUIVALENCE (A, B) _____

b. EQUIVALENCE (D, E) _____

c. EQUIVALENCE (A, C) _____

d. EQUIVALENCE (A, E), (B, F), (F, E) _____

_____

1. A program that calls subroutines may include the names of other functions or subroutines as parameters in the calling sequence if the functions or subroutines are defined in _____ statements.

2. Where must the statements appear relative to the calling sequence? _____

3. Suppose TAN1 is a function that computes A/B defined as follows:

```
      FUNCTION TAN1(A, B)
      IF (B .EQ. 0.0) GO TO 5
      TAN1 = A/B
      RETURN
    5 TAN1 = 999999999.
    6 RETURN
      END
```

Suppose you know that $\tan\Theta = \sin\Theta/\cos\Theta$ and you know that library functions SIN and COS are available. Write the steps to set TT equal to the tangent of THETA using functions TAN1, SIN, and COS.

_____

_____

Exercise V.J

1. Name the three general methods for handling oft-repeated functions in a main program.

   a.) _____

   b.) _____

   c.) _____

2. a.) Where is the statement function described?
   b.) How is it referenced?

3. Consider the general form of the statement function

$$\text{NAME}\ (P_1,\ P_2,\ \ldots,\ P_n) = \text{EXP}$$

   a.) The upper and lower limits for n are _____ and _____.

   b.) The P's represent _____ _____ and must be _____ _____.

4. a.) The rules for naming statement functions and function subprograms are alike in that the name implies _____. b.) Conversely, a subroutine name is not associated with the _____ of the variable(s) involved.

5. How does FORTRAN distinguish between statement functions and subscripted variables?

6. Write the FORTRAN statement(s) necessary to define the statement function named CALC which adds three parameters and divides their sum by 9.3.

7. The _____ subprogram is used to calculate a single result, whereas the _____ subprogram may not calculate anything or may perform several calculations to be returned to the main program.

8. A subroutine name must be the same in both the main program and the subroutine itself. True or false? _____ The parameters, if any, in the main program and subroutine must have the same variable names. True or false? _____

9. May one subroutine reference another? _____

10. Write a general FORTRAN statement for referencing a subroutine.

_____

11. In using the COMMON statement the order of assignment to the common area of memory and the naming of variables are equally important. True or false? _____

Exercise V.J (Continued)

12. a.) The common area with no name is called _____ _____. Those common areas with names are called _____ _____.

b.) Different common blocks are identified by _____.

c.) A labeled common name may be the same as a _____ name used within the program but cannot be the same as a _____ name.

13. What, if any, are the errors in the following statements?

a.)
```
COMMON/MANY/M, A, N, Y
COMMON A, K
```

b.)
```
COMMON/123T4/F, E, WHAT
```

c.)
```
DIMENSION ARRAY (10), BITS (5)
COMMON WORK, ARRAY (11), BITS, KMON
```

d.)
```
COMMON/STUFF/IOP, NOP, SAP
COMMON/TOUGH/HARRY, SAM, JOE, SAL
```

14. When is it acceptable to define array limits using variable dimensions?

15. List the advantages of the block data subprogram over a.) storing input data on cards and b.) writing constants into the program. (Assuming a large number of values.)

16. What is the disadvantage of the block data method?

17. There are no _____ permitted in a block data subprogram.

Exercise VI.A

1. For what type of number is the Dw.d conversion used?

_____

2. Which other type of conversion does the Dw.d conversion most closely resemble?

_____

3. What is the largest permissible magnitude for the exponent of a Dw.d number?

_____

Exercise VI.B.

1. To which two other conversions does the Gw.d conversion correspond?

_____

2. When is E-type conversion used for a Gw.d specification?

_____

3. In core, variable X contains the value 1273.4793365. What will be output for

```
    PRINT 100, X
100 FORMAT (G11.3)
```

_____

4. In core, variable Y also contains the value 1273.4793365. What will be output for

```
    PRINT 200, Y
200 FORMAT (G14.4)
```

_____

5. In core, variable Z contains the value 5977342.100177. What will be output for

```
    PRINT 300, Z
300 FORMAT (G8.4)
```

_____

6. To output the value 12345.6789, which conversion will be used for the following specifications? How will the output look?

a.) G11.1 b.) G11.4 c.) G11.0

d.) G13.6 e.) G10.1

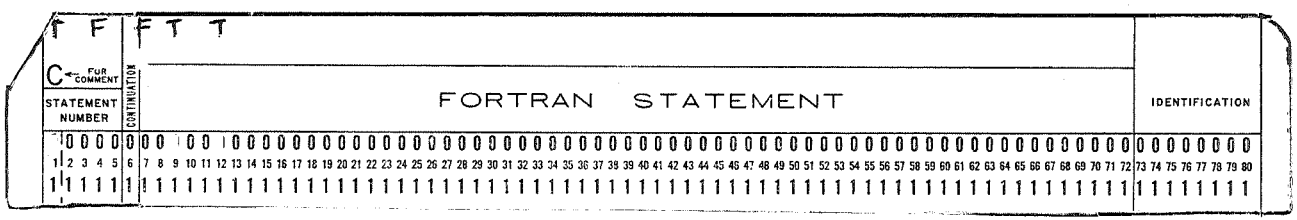
a. _____
b. _____
c. _____
d. _____
e. _____

Exercise VI.C

1. For what type of data is Lw conversion used?

_____

An input card is punched



In core, variables YES, NO, and MAYBE have the values true, false, and false, respectively.

2. What will be the values of A, B, C, and D if the card is read by

```
      READ 100, A, B, C, D
  100 FORMAT (L3, L4, L3, L2)
```

A= _____

B= _____

C= _____

D= _____

3. What will the output be for

```
      PRINT 876, YES, NO, MAYBE
  876 FORMAT (L6, L10, L2)
```

_____

For the same input card, and the same initial values in core for YES, NO and MAYBE, consider this code:

```
    PRINT 1, YES, NO, MAYBE        (1)
  1 FORMAT (L4, L4, L4)            (2)
    READ 2, YES, NO, MAYBE         (3)
  2 FORMAT (L1, L7, L1)            (4)
    PRINT 1, YES, NO, MAYBE        (5)
```

4. What will the output from (1) be?

_____

5. What will the output from (5) be?

_____

Exercise VI.D

1. The variable XTEST contains the value .006879. What value is printed if XTEST is output according to the format specification 3PF6.2? _____

2. What effect does the scale factor have on the conversion of integers (I conversion)?

_____

3. Suppose that a scale factor of 3 is currently effective. How many places will be printed to the left of the decimal point if 26.379246 is printed with an E12.3 conversion? _____

1. Arrays ANGLE and KOUNT are dimensioned for 25 locations and contain the following values.

ANGLE: -0.001354, -0.2986237986, 5.472547254, 17.963287 and 101.2013275

KOUNT: 101, 102, 103, 104 and 105

Use the coding form below to show the output results of

```
      PRINT 976 (KOUNT(I), ANGLE (I), I = 1, 5)
  976 FORMAT (20X, 5HCOUNT, 10X, 5HANGLE//(I25, 3X, E20.7) )
```

FORTRAN CODING FORM

C for Comment

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

Exercise VI.F

1. For what type of data is Aw conversion used?

_____

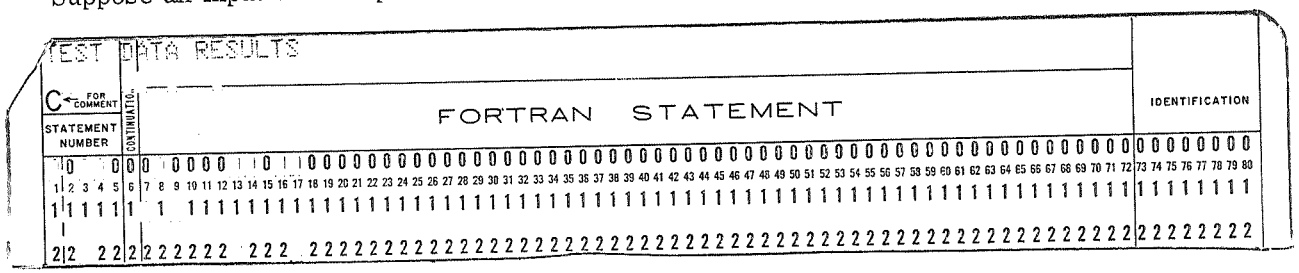
2. What code does Aw conversion utilize?

_____

3. How many A-type characters may be stored in one CDC 6000 series computer word?

_____

Suppose an input card is punched



4. What would be read by

```
      READ 007, HDG
007   FORMAT (A10)
```

HDG _____

5. What would be read by

```
      READ 86, HEAD1, HEAD2
86    FORMAT (2A10)
```

HEAD1 _____

HEAD2 _____

6. What would be read by

```
    READ 99, HEAD1, HEAD2
99  FORMAT (A10, A7)
```

HEAD1 _____

HEAD2 _____

7. What would be read by

```
    READ 456, HEAD1, HEAD2
456 FORMAT (A7, A10)
```

HEAD1 _____

HEAD2 _____

Exercise VI.G

Three variables in core contain values as follows:

Variable	Value
MONTH	04050305150205225555_8 D E C E M B E R b b
NDAY	00000000000000000031_8
YEAR	56553444414255555555_8 , b 1 9 6 7 b b b b

1. What will the output be for

```
    PRINT 10, MONTH, NDAY, YEAR
10  FORMAT (A9, I2, A6)
```

_____

2. What will the output be for

```
    PRINT 20, MONTH, YEAR
20  FORMAT (A3, A6)
```

_____

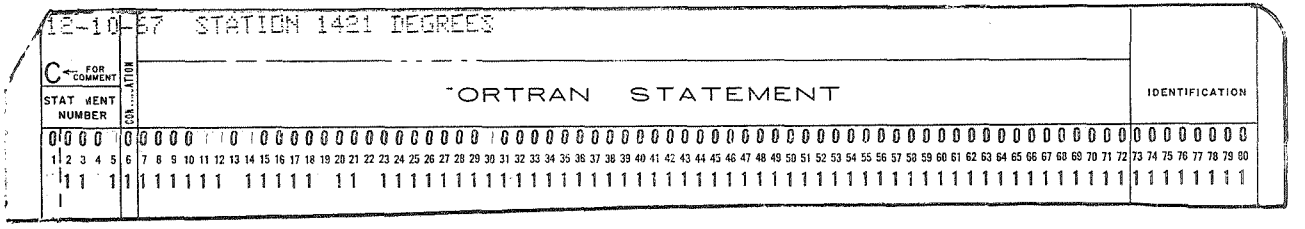
3. What will the output be for

```
    PRINT 30, MONTH, NDAY
30  FORMAT (A3, I3)
```

_____

1. For what type of data is Rw conversion used? _____

An input card is punched as follows:



The console display code for the characters punched on the card is

Character	Code	Character	Code
A	01	T	24
D	04	0	33
E	05	1	34
G	07	2	35
I	11	4	37
N	16	6	41
O	17	7	42
R	22	-	46
S	23	blank	55

Exercise VI.H (Continued)

2. What octal values will be stored in memory for

```
    READ 17, DATE, STATN, TEMP
17  FORMAT  (A10, R10, R2)
```

DATE= _____

STATN= _____

TEMP= _____

3. What octal values will be stored in memory for

```
    READ 956, DATE, HEDNG1, STANO, TEMP, HEDNG2
956 FORMAT  (A8, A10, R2, R2, A8)
```

DATE= _____

HEDNG1= _____

STANO= _____

TEMP= _____

HEDNG2= _____

4. What octal values will be stored in memory for

```
    READ 5, DATE, HEDNG1, STANO, TEMP, HEDNG2
5   FORMAT (R8, R10, A2, A2, R8)
```

DATE= _____

HEDNG1= _____

STANO= _____

TEMP= _____

HEDNG2= _____

In core are stored these values:

LABEL 1: 14012411242504055555

L A T I T U D E b b

LABEL 2: 14171607112425040555

L O N G I T U D E b

LABEL 3: 01142411242504055555

A L T I T U D E b b

5. What will the printout be for

```
    PRINT 14, LABEL1, LABEL2, LABEL3
14  FORMAT (A10, R10, A10)
```

_____

6. What will the printout be for

```
    PRINT 29, LABEL1, LABEL2, LABEL3
29  FORMAT (A3, A4, A3)
```

_____

7. What will the printout be for

```
    PRINT 92, LABEL1, LABEL2, LABEL3
92  FORMAT (R3, R4, R3)
```

_____

Exercise VI.I

1. For what type of number is Ow conversion used? _____

2. How many O-type digits are contained in a single CDC 6000 series computer word? _____

3. Which of the following numbers are not suitable for input by an O15 specification?

   A. bbb433714662155
   B. 137434221531362
   C. bb2232568133412
   D. bbbbbbbbbbbbb29

   _____

In core the variable OCTAL contains the value 22431777125673244313_8

4. What will be output by

```
     PRINT 982, OCTAL
982  FORMAT (O10)
```

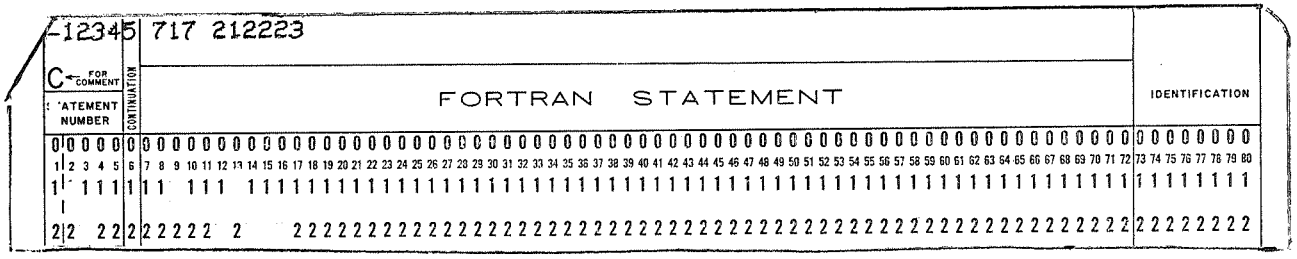
   _____

5. What will be output by

```
     PRINT 8, OCTAL
8    FORMAT (O23)
```

   _____

6. An input card is punched



What values will be stored in the computer by

```
      READ 15, OCT1, OCT2, OCT3
   15 FORMAT (O6, O4, O7)
```

OCT1= _____

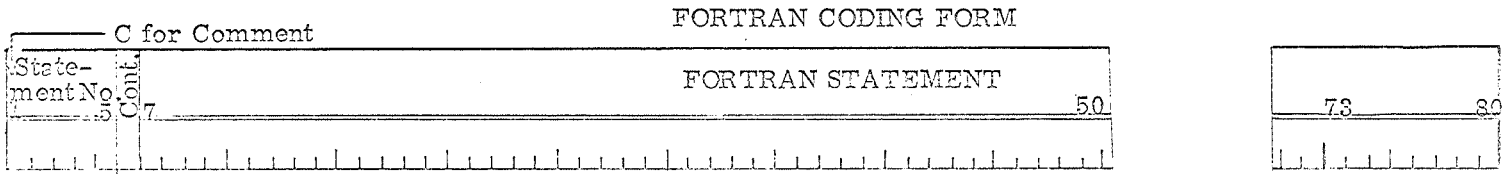
OCT2= _____

OCT3= _____

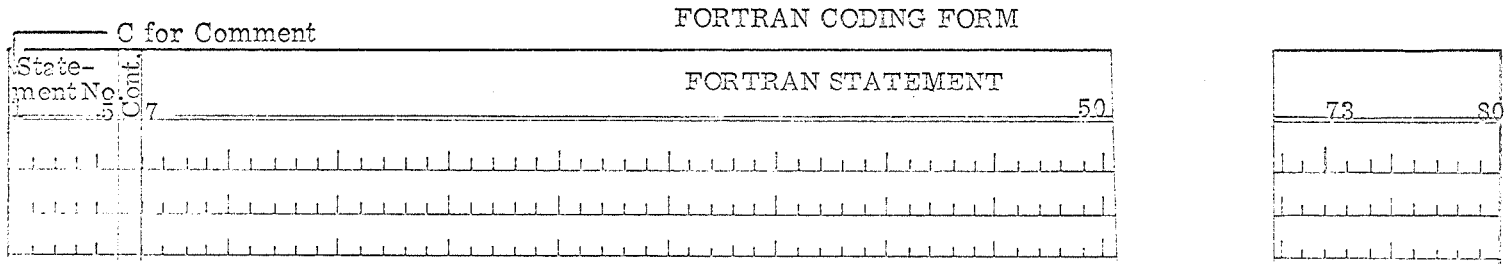
Exercise VI.J

1. Write a FORMAT statement which may be used to read data cards containing:

   a.) an integer in columns 1 - 10
   b.) an integer in columns 11 - 15
   c.) an integer in columns 16 - 22
   d.) seven characters in columns 25 - 31
   e.) a real number of the form xx.xxx in columns 35 - 40.



2. Write the DIMENSION, FORMAT, and READ statements which will enter the format specifications from problem 1 into the array FMT1.



3. The READ statement in problem 2 will cause the format specifications to be read into the array FMT1. The first non-blank character on the card containing these specifications starts with a _____.

4. Assume the format from problem 1 has been read into the array FMT1. Write the READ statement which will read the values from the data card described in problem 1.

_____

5. In the following program, write the format specifications which must be input to the array FMT2 in order to:

a.) Print 10 values per line.
b.) Print 6 values per line.
c.) Print 7 values per line.
d.) Print, alternately, 10 values per line and 5 values per line.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DIMENSION X(1000), FMT2(8)	
C		SUBROUTINE SOLVE RETURNS 1000	
C		VALUES IN THE ARRAY	
		CALL SOLVE (X)	
		READ 10, (FMT2(I), I=1,8)	
10		FORMAT (8A10)	
		PRINT FMT2, (X(J), J=1,1000)	
		CALL EXIT	
		END	

Exercise VI.J (Continued)

5. (Cont.) Spec. a.) _____

Spec. b.) _____

Spec. c.) _____

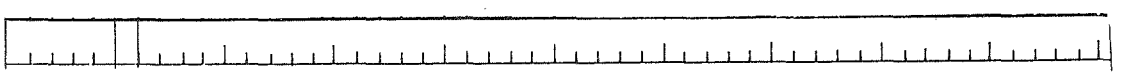
Spec. d.) _____

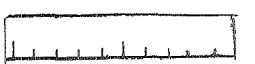
1. There exists an analogy between formatted I/O statements and the ENCODE/DECODE statements. The ENCODE statement parallels output since it causes conversion from binary to _____. The DECODE statement parallels _____, since data is transformed from an existing BCD form into a binary form specified by a FORMAT statement. All conversions, however, remain within the computer _____ rather than causing transfers through an external I/O device.

2. Given the following DIMENSION and FORMAT statements:

```
    DIMENSION X(3), Y(3), Z(10)
  2 FORMAT (3F7.2, 3E14.8, 2I5)
```

write an ENCODE statement which will produce an eighty-character record beginning in location Z(1), containing the data in locations X(1), X(2), X(3), Y(1), Y(2), Y(3), I, J converted according to the above FORMAT.





3. Examine the following set of instructions:

```
    DIMENSION X(8), Y(4)
    ENCODE(40, 5, X) (Y(I), I=1, 4)
  5 FORMAT (4F8.3)
```

Answer these questions concerning the above instruction set.

Exercise VI.K (Continued)

3. (Continued) a.) Upon execution of the ENCODE statement, what is the length (in console display code characters) of the resulting record?

Answer: _____

b.) How many locations in the X array are filled during execution?

Answer: _____

c.) If the values in the Y array are given as 1.25, 2.50, 3.75, 5.0 in succession, what 10 characters will be contained in X(1) after execution?

Answer: _____

d.) What is the contents of X(4) as a result of executing the ENCODE statement?

Answer: _____

4. If X=10HDATA5.2833 and the instruction DECODE(10, 2, X) VALUE, H, I is executed, what will be in locations VALUE, H, I if statement 2 has the form: 2 FORMAT (A4, F4.2, I2)?

VALUE: _____

H: _____

I: _____

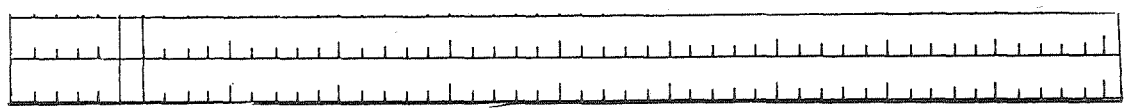
5. The variable Z has been dimensioned 2 with each location being defined as follows:

```
Z(1)=10HINPUTb1250
Z(2)=10H3.1415b757
```

Write the DECODE and FORMAT statement which will use a 20-character record of BCD information at Z to assign the values:

INPUT to a variable named TYPE
1250 to a variable named N1
3.1415 to a variable named PI
757 to a variable named N2.

The length of the variables TYPE and PI is expected to be six characters each while the length of the variable N1 and N2 is expected to be four characters each.



Exercise VI.L

1. Give the DIMENSION and WRITE statements to write 1000 values from the array X(2000) onto tape 7 in binary (unformatted).

C for Comment

FORTRAN CODING FORM

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

2. A binary (unformatted) tape is provided which contains 10 records. Each record is composed of fifty integers followed by fifty real values. Read this binary tape on unit 7 and write in unformatted form the first and tenth records onto tape 9.

C for Comment

FORTRAN CODING FORM

Statement No. 1–5	Cont.	FORTRAN STATEMENT 7–50	73–80

1. Write the statement which will leave tape 7 positioned at load point (beginning of the tape).

_____

2. Write a statement which will branch to statement 200 if an end-of-file indicator was encountered on the last read on tape 7. Otherwise, branch to statement 400.

_____

3. Assume that tape unit 7 is positioned ready to read record 10. Write the instructions which will position tape unit 7 ready to read record 8.

_____

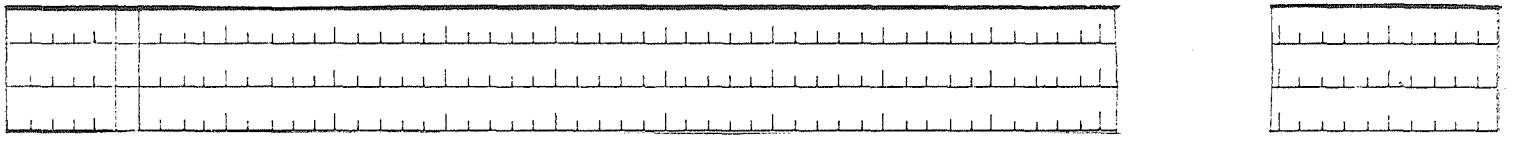
Exercise VI.N

1. The following three statements set up a NAMELIST type read.

```
DIMENSION A(5), B(6), K(3)
NAMELIST/ALIST/A, B, K
READ (5, ALIST)
```

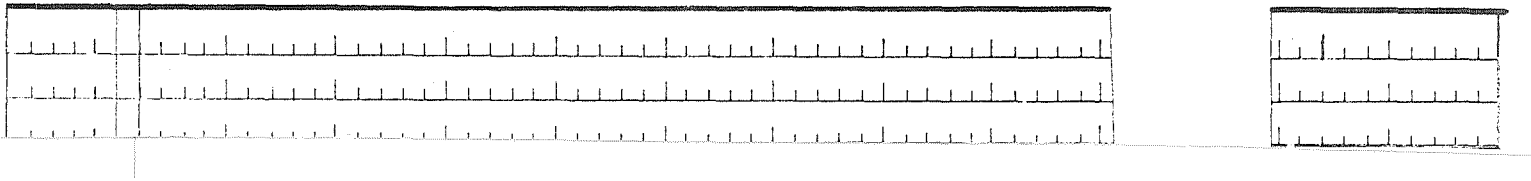
Show the input data card required by the READ statement to set the following values.

A(1)=1.3, A(2)=2.5, A(3)=5.0, A(4)=5.0, A(5)=5.0,
B(2)=8.3, B(5)=.25, K(1)=5, K(2)=3, K(3)=0



2. Write the three statements required to set up a NAMELIST type read to meet the following specifications.

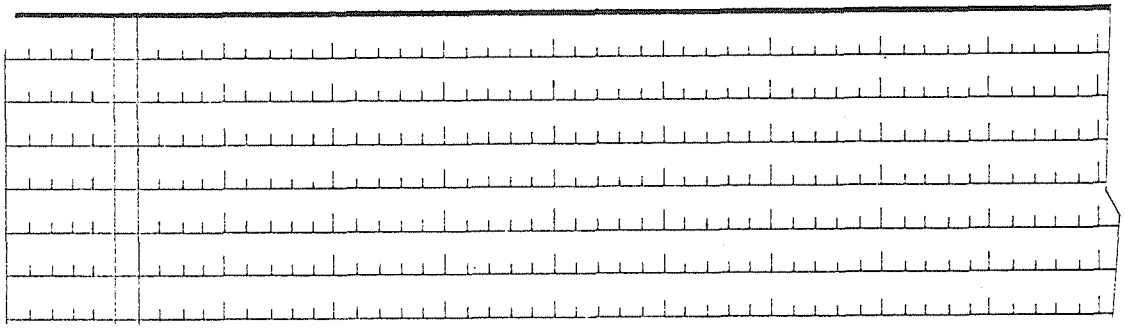
a.) The NAMELIST name is XARRAY
b.) The variables under this NAMELIST are X(10), Y(5), Z(20), K, B, L
c.) The input unit number is 5.

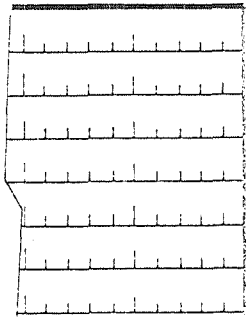


3. In the following list of statements, the NAMELIST statement has been left out. Fill in the proper NAMELIST statement and then provide the input data card(s) to accomplish each of the following.

a.) Set A(3)=5.2, A(5)=6.0
b.) Set A(1)=0, A(2)=0, A(3)=0, A(4)=0
c.) Set A(4)=9.2, K=3, R=6.8
d.) Set A(1)=1.0, A(2)=1.0, A(3)=9.3, A(5)=5.5, K=7
e.) Don't change anything

```
DIMENSION A(5)
DATA (A(I), I=1, 5), K, R/1.0, 2.0, 3.0, 1.5, 3.2, 9, 1.2/
NAMELIST
READ(5, TLIST)
```





Exercise VI.N (Continued)

4. If in the preceding problem the statement WRITE(10, TLIST) appeared after the READ statement, what values would be written on tape 10 for each of the cases a.) through e.) ?

Exercise VI.P

1. Any single line of coding--any acceptable FORTRAN statement, continued statement, END card, or comment--may be thought of as a card _____.

2. Which card (FORTRAN statement) signifies to the compiler that preceding lines of coding are to be grouped together as a program or subprogram?

   Answer: _____

3. A file of executable programs is comprised of at least a _____ program and possibly one or more _____.

4. Certain routines which govern the overall course of action of the computer, such as reading in your program and allocating memory space are called _____ routines.

5. Write a program card which precedes the deck called MAIN, and indicates the use of four systems files. The systems files include the card reader and printer, an input tape called TAPEIN, and an output tape called DATA.

_____

II.A

1. (1) exponentiation **
   (2) multiplication *
   (3) division /
   (4) addition +
   (5) subtraction -

2. 7

3. letter

4. (1) A**2
   (2) A**2
   (3) TEMP/OVER
   (4) -D
   (5) (K - L)

5. seven

6. continuation

7. first

8. 99999

9. exponentiation

10. six

11. R = C/(2.0*PI)
    AREA = PI * R * * 2

ANSWERS

II.A 12. (1) $A + B\frac{C}{D}F + \frac{G^2}{R}$

(2) $3.0\frac{\Phi^2}{D}C - P$

(3) $\frac{A}{B}CD - \frac{4.0}{A}F$

(4) $\frac{X^2}{Y}C + \frac{Y^2}{X}A$

(5) $\frac{GT^2}{CD} - AB$

ANSWERS

II.B

1. integer, real
2. floating point
3. I, J, K, L, M, N
4. letter
5. decimal point
6. Y = (X**2 - 3.0*X + 1.0) / (X*(X-1.0)**2)
7. (1) .96E-4
   (2) 20.0
   (3) 20.6E2
   (4) 8.0E-8
   (5) 2.0E8
8. 20.0, 40.0
9. integer
10. 5

ANSWERS

II. C

2.
(1) KK is subtracted from JJ in the fixed-point mode.
(2) The result of Step 1 is converted to floating point.
(3) The result of Step 2 is assigned to Z.

3.
(1) Z is squared.
(2) The result of Step 1 is divided by 4.0.
(3) The result of Step 2 is multiplied by A.
(4) The result of Step 3 is multiplied by C.
(5) L is converted to floating-point.
(6) The result of Step 5 is multiplied by Y.
(7) The result of Step 6 is multiplied by SIGMA.
(8) The result of Step 7 is added to the result of Step 4.
(9) The result of Step 8 is assigned to X.

4.
(1) K is converted to floating point.
(2) 3.2 is multiplied by result of Step 1.
(3) The result of Step 2 is added to 1.5.
(4) The result of Step 3 is multiplied by X.
(5) The result of Step 4 is added to 4.1.
(6) The result of Step 5 is multiplied by X.
(7) The result of Step 6 is added to 26.0.
(8) The result of Step 7 is assigned to POLY.

5.
(1) X3 is subtracted from X4.
(2) Y3 is subtracted from Y4,
(3) The result of Step 2 is divided by the result of Step 1
(4) The result of Step 3 is assigned to SLOPE.

ANSWERS

II.D

1.
```
DIMENSION A(3,3), B(3), C(3)
C(1) = A(1,1)*B(1) + A(1,2)*B(2) + A(1,3)*B(3)
C(2) = A(2,1)*B(1) + A(2,2)*B(2) + A(2,3)*B(3)
C(3) = A(3,1)*B(1) + A(3,2)*B(2) + A(3,3)*B(3)
```

2.
```
SUM = A(K,1) + A(K,2) + A(K,3)
```

3.
```
DIMENSION T(90,24)
T(6,10) = (T(6,9) + T(6,11))/2.0
```

4.
```
T(6,10) = (T(4,10) + T(5,10) + T(7,10) + T(8,10))/4.0
```

5.
```
TEMP = .5 * (T(66,9) - T(66,8) ) + T(66,8) or TEMP = .5*(T(66,8)+T(66,9))
```

6.
```
DTEMP = T(66,9) - T(66,8)
DTEMP = .5*DTEMP
TEMP  = DTEMP + T(66,8)
```

ANSWERS

II.E

1.

integer	integer
real	real
complex	complex
double precision	double precision
logical	logical
	octal
	Hollerith

2. complex, double precision, logical

3. double precision, real, integer, complex, real, double precision, integer, logical

4. 20

5. right, zeros, left

6. COMPLEX Y
   Y = ((3.0, 4.0) * (-1.0, 2.0))/((-1.0, -1.0) * (3.0, - 1.0))

7. Hollerith, six, numeral, four

8. .FALSE.

II. F

1.

(1)	.TRUE.
(2)	.FALSE.
(3)	.FALSE.
(4)	.FALSE.
(5)	.TRUE.
(6)	.TRUE.
(7)	.TRUE.
(8)	.FALSE.
(9)	.FALSE.
(10)	.TRUE.

2.

	M	N	NCOM
(1)	.TRUE.	.FALSE.	.TRUE.
(2)	.FALSE.	.FALSE.	.TRUE.
(3)	.TRUE.	.TRUE.	.FALSE.
(4)	.TRUE.	.FALSE.	.TRUE.
(5)	.FALSE.	.TRUE.	.FALSE.

3.

(1)	7777
(2)	50
(3)	0
(4)	7
(5)	0

ANSWERS

II.G

1. not a problem

2. zero

3. zero

4. not a problem

5.
(1) Convert real value X to complex.
(2) Multiply result of Step 1 by complex value D.
(3) Convert integer I to complex.
(4) Add result of Step 3 to result of Step 2.
(5) Convert result of Step 4 to real.
(6) Assign result of Step 5 to X.

6.
(1) Convert real value X to complex.
(2) Multiply result of Step 1 by complex value D.
(3) Convert real value Y to complex.
(4) Add result of Step 2 and result of Step 3.
(5) Assign result of Step 4 to C.

7.
(1) Add C(1) to C(2).
(2) Add result of Step 1 to C(3).
(3) Convert integer J to complex.
(4) Multiply result of Step 2 by result of Step 3.
(5) Convert integer constant 1 to complex.
(6) Subtract result of Step 5 from result of Step 4.
(7) Assign complex result to D.

8.
(1) Convert integer constant 4 to real.
(2) Add result of Step 1 to X.
(3) Convert double precision value Y to complex.
(4) Convert result of Step 2 to complex.
(5) Multiply result of Step 3 by result of Step 4.
(6) Subtract complex value G from result of Step 5.
(7) Assign complex result to F.

II. H

1. (1) addition
   (2) subtraction
   (3) multiplication
   (4) division
   (5) exponentiation

2. (1) exponentiation
   (2) multiplication and division
   (3) addition and subtraction

3. first

4. (1) integer
   (2) real
   (3) double precision
   (4) complex
   (5) logical

5. (1) integer
   (2) real

6. real

7. (1) integer — 12
   (2) real — 6.0
   (3) double precision — 4.0D0
   (4) complex — (2.0, 3.5)
   (5) logical — .TRUE.
   (6) octal — O000006
   (7) Hollerith — 6HAT BAT

8. subscripted variable

9. true

10. false

11. no

ANSWERS

II. H

12. DIMENSION A (100), B (50, 2), C (2, 10, 5)

13. letter

14. DOUBLE PRECISION POLY
COMPLEX CAPL

15. (1) double precision
(2) complex
(3) logical

III. B

1. a.) computed
   6

   b.) assigned
   6

   c.) unconditional
   6

   d.) assigned
   20

   e.) computed
   30

2. a.) NTABLE(1,2,2)

   b.) 25.0, 4.0

   c.) (1) 6
   (2) 2.0

   d.) (1) 4
   (2) 3

   e.) (1) 11
   (2) 1, 3, 5, 7, 9, 11, 13, 15, 17, 19

ANSWERS

III. B 3. a.) Any of these for the first statement:

```
I = 1
I = 2
I = 3
I = 4
```

b.) GO TO (10, 99, 3, 1), NUMBER

c.) GO TO JSWCH

d.) Any of these for the first statement:

```
I = 1
I = 2
I = 3
```

e.) Any of these for the first statement:

```
J = 1
J = 2
J = 3
```

f.) Make spelling the same for the variable. Correct either line:

```
    ASSIGN 50 TO ISWTCH
or  GO TO ISWCH
```

g.) ASSIGN 10 TO I (or J, K, L, M, or N, etc.)
GO TO I (20, 30, 10) (or J, K, L, M, or N, etc.)

III. B

4.

```
      GO TO (9,11,12),J
    9 P = 1.0
      GO TO 20
   11 P = X
      GO TO 20
   12 P = X**2
```

5. a.)

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		GO TO 50	

b.)

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		ASSIGN 50 TO J	
		GO TO J	
		ASSIGN 50 TO J	
		GO TO J(20,50,40)	

or

ANSWERS

III. B 5. (Cont.)

c.) There are many possible methods. A few might be:

FORTRAN CODING FORM

C for Comment

	Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
			I = 1	
	60		GO TO (50, 30), I	
or				
			N= 0	
	60		I = N+ 1	
			GO TO (50, 12, 30), I	
or				
			J =4	
	60		GO TO (20, 35, 3, 50, 6), J	

III. C

1. a.) A .GT. B .AND. A .LT. C
   b.) A .GT. B .AND. A .LE. C
   c.) A .AND. B .AND. .NOT. C
   d.) A .EQ. B .AND. A .NE. C
   e.) A .EQ. B .OR. C .EQ. D

2. 4_8

3. Ones, zeros

4. a.) true, false
   b.) false, true
   c.) ---- , false

ANSWERS

III. D

1. a.) negative, zero, positive

   b.) true (all ones), false (all zeros)

   c.) true, false

2. a.) IF (I-1)20, 30, 30

   b.) IF (I-1)20, 20, 30

   c.) IF (INDEX-400)10, 40, 40

   d.) IF (A-B)25, 60, 30

3. a.) N = (JCOUNT-1)/2
   IF(N) 10, 35, 35

   b.) R = 8.*(X+10.)
   IF(R)30, 50, 40

   c.) N = 100-MAX
   IF(N)50, 50, 100

   d.) R = 100.-SUM
   IF(R)20, 10, 35

   e.) R = B*X**2-2.*Y/(A*Z)
   IF(R)55, 100, 100

   f.) N = (M*K)**2-2*(I+K)
   IF(N)70, 60, 70

III. D 4.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		IF (A-B) 2, 2, 1	
1		IF (A-C) 70, 50, 50	
2		IF (A-C) 100, 70, 70	

5.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		IF (A-21.0) 20, 10, 10	

6. a.) - Periods around EQ are missing

b.) - Parentheses should enclose A. EQ. B

c.) - Comma after the parentheses is incorrect

d.) +

ANSWERS

III. D

7. a.) +

b.) - not a valid logical expression

c.) - not a valid FORTRAN statement after the control expression

d.) +

e.) - there must be an "executable" statement after the control expression; a type statement is not "executable"

f.) +

8.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont. (6)	FORTRAN STATEMENT (7–50)	(73–80)
		NOTFRST = .FALSE.	
20		IF (NOTFRST) GO TO 40	
		ISTART = 1	
		NOTFRST = .TRUE.	
40		(program continues)	

ANSWERS

III. E

1. DO, DO

2. incremented, maximum

3. a.) (1)
   b.) (1)
   c.) (2)
   d.) (1)
   e.) (1)
   f.) (1)
   g.) (1)

4. a.) 10
   b.) 1
   c.) MAX times
   d.) 7
   e.) 2
   f.) 7

5. (2)

ANSWERS

III. E

6. a.) invalid
   b.) valid

7. a.) no
   b.) yes
   c.) yes
   d.) no
   e.) no
   f.) no
   g.) no
   h.) yes
   i.) yes
   j.) no

III. E 8.

```
10    DO 5 I = 1, 99

3     IF (VALUE(1) .LT. VALUE(J)) 5, 6

8     VALUE (J) = X

5     CONTINUE
```

9.

FORTRAN CODING FORM

C for Comment

Statement No (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DIMENSION INDEX (400)	
10		DO 30 I=1, 400	
		INDEX (I) = I	
30		CONTINUE	
		(rest of program)	

ANSWERS

III. E 10.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DIMENSION ISUM(30)	
		ISUM(30) = 0	
20		DO 25 I = 1, 29	
		ISUM(30) = ISUM(30) + ISUM(I)	
25		CONTINUE	
		IF(ISUM(30) .GE. 100) GO TO 45	
30		LITTLE = ISUM(30)	
		GO TO 50	
45		LARGE = ISUM(30)	
50		(program continues)	

III. E 11.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DO 95 I=1, MAX	
		IF (SUM .LT. VALUE) 90, 100	
90		SUM = SUM * 2.0	
95		CONTINUE	
100		(program continues)	
C		OTHER VALID IF STATEMENTS INSTEAD OF THE	
C		ABOVE COULD BE IF(SUM .GE. VALUE) 100, 90	
C		OR IF (SUM .GE. VALUE) GO TO 100	
C		OR IF(SUM - VALUE)90,100,100	

ANSWERS

III. E 12.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DIMENSION MIXED(5)	
		DO 20 I = 1, 4	
		ISEC = I+1	
		DO 20 J = ISEC, 5	
		IF(MIXED(I) - MIXED(J)) 20, 20, 10	
10		ITEMP = MIXED(J)	
		MIXED(J) = MIXED(I)	
		MIXED(I) = ITEMP	
20		CONTINUE	

III. E 13.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)
		DIMENSION MAP(1000), IPOS(1000), INEG(1000)
C		CLEAR THE 5 ACCUMULATORS
		IZERO = 0
		IPOSM = 0
		INEGM = 0
		K = 0
		J = 0
		DO 5555 I = 1, 1000
		IF (MAP(I)) 1, 2, 3
1		J = J+1
		INEG(J) = MAP(I)
		INEGM= INEGM + MAP(I)
		GO TO 5555
2		IZERO = IZERO + 1
		GO TO 5555
3		K = K+1
		IPOS(K) = MAP(I)
		IPOSM = IPOSM + MAP(I)
5555		CONTINUE

73 80

ANSWERS

IV. C

1. To specify which data items are to be transmitted, and their order.
2. By a comma
3. 19 continuation cards
4. Yes
5. (A (IX), B(IX, 1), IX = 1, 5)
6. C
7. 10
8. A(1), B(1, 1), A(2), B(2, 1), A(3), B(3, 1), A(4), B(4, 1), A(5), B(5, 1)
9. 11
10. I(1), I(2), I(3), I(4), I(5), I(6), B(1, 2), B(2, 2), B(3, 2), B(4, 2), B(5, 2)
11. 27
12. C(1, 1, 1), C(2, 1, 1), C(3, 1, 1), C(1, 2, 1), C(2, 2, 1), C(3, 2, 1)
13. 4
14. (J(IX, 1), IX = 1, 4)
15. The last item of the list should not be followed by a comma.

IV. C

16. There should be commas after CAT and DOG

17. Yes

18. The implied DO loop should be enclosed in parentheses.

19. No fault

20. READ 100, (((ARRAY (I, J, K), I=1, IMAX), J=1, JMAX), K=1, KMAX)

ANSWERS

IV.D

1. A FORMAT statement
2. By the FORMAT statement number
3. Yes
4. No
5. In columns 1-5
6. Beginning in column 7 or beyond
7. Any place, except not as the last statement of a DO loop.
8. Yes or No
9. Yes, if continue is indicated in column 6 of all but the first line.
10. There is no maximum.

ANSWERS

IV. E

1. Real number with exponent

2. The entire output field width

3. The number of fractional places to be output to the right of the decimal point

4. $w \geq d+7$

5. b3.14159E+00bbb5.280E+03b6E+01bbb1.745E-02b6.378E+03

6. bbbbb3E+00bbbbb6E+03

7. b5.28E+03

8. b1.745329E-02bbb5.730 E+01

ANSWERS

IV. F

1. A = 3.14
   B = 159.5280
   C = 6.378×10^{30}
   D = .017453

2. W = 3.14159
   X = 5280.0
   Y = 6378.0
   Z = 0.017453

3. PI = 3.1415952806
   RAD = $.378 \times 10^{30}$
   DTR = 0.017453

ANSWERS

IV.G

1. Real number without exponent
2. The entire output field width
3. The number of places to be output following the decimal point
4. Yes
5. The decimal point and fractional places are not output.
6. Yes, for negative numbers only
7. bbbbb.0175bb638.3880b5280.0000
8. 3.14bb57.2957795b638
9. bbb.017453
10. b3b5280b57bbbbb638

ANSWERS

IV.H

1. VAL = 123.45
   YDS = 1760.0
   SQT = 89.44272
   SQ = 640000.0

2. A = 12345.17
   B = 60.08
   C = 9.44272640000

3. ONE = 123451760.0
   TWO = 89.442726

ANSWERS

IV.I

1. Integer

2. I = 9362
   J = 17741
   K = 666
   L = 450

3. N1 = 93620
   N2 = 177
   N3 = 410

4. MA = 936201
   MB = 774
   MC = 10066

5. bbbb1b144012345

6. bbb1440bb1440b1440

7. bbb1234567890

8. bb12345b365b1b1440b67890

ANSWERS

IV.J

1. To skip card columns

2. To leave blanks in the printed line

3. IX = 13
   VAL = 245.9322

4. K = 130
   X = 245.9322
   IYEAR = 1965

5. V1 = 93.22
   I1 = 1

6. bbbbbbbbbbWEEKb34bbb2NDbDAYbbYEARb1967

   bb10.9bb20.6bbb30.0

ANSWERS

IV.K

1. Slash
2. 4
3. 6
4. 4
5. 5
6. 5
7. blank, blank, printed, printed, printed

ANSWERS

IV. L

1. Hollerith or alphanumeric

2. FORMAT

3. input

4. False

5. Console display code

6. bINPUTbCOMPONENTSb-bTYPEb1bbbb
bbbbb122.6bbbbb147.2bbbbb826.9
bLATITUDEbANDbLONGITUDEb--bbbb
bbbbb-22.6bbbbb133.0

7.
```
    DIMENSION VALUE(5)
    DATA(VALUE(I), I=1,5)/5*0.0/
or  DATA(VALUE(I), I=1,5)/0.0, 0.0, 0.0, 0.0, 0.0/
or  DATA VALUE/5*0.0/
or  DATA VALUE/0.0, 0.0, 0.0, 0.0, 0.0/
```

8.
```
    PRINT 10
10  FORMAT (15HbIbLIKEbFORTRAN)
```
or
```
    PRINT 10
10  FORMAT (1X,*IbLIKEbFORTRAN*)
```

V.A

1. a.) STFNXY
   b.) X, Y
   c.) $X^2 + 24\ XY$
   d.) precede

2. a.) actual
   b.) 13.0

3. HSININV(X) = ALOG (X+SQRT(X**2+1.0))

4. see next page

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)
		Y(X)=A*SIN(2*3.1415926*((TSM/T)-(X/AMBA)))
C READ CONSTANTS		
		READ 10,A,T,AMBA,N
10		FORMAT(3F15.3,I5)
		PRINT 20,A,T,AMBA
20		FORMAT(1H1,9X,11HAMPLITUDE =,F12.4,10X,
	1	8HPERIOD =,F12.4,10X,13HWAVE LENGTH =,F12.4)
		PRINT 30
30		FORMAT(1H ,9X,12H TIME,10X,
	1	12H DISTANCE,10X,12HDISPLACEMENT)
		I=1
C READ VARIABLE DATA AND COMPUTE		
35		READ 40,TSM,X1,X2,X3
40		FORMAT (4F15.3)
		Y1=Y(X1)
		PRINT 50,TSM,X1,Y1
50		FORMAT(3F22.4)
		Y1=Y(X2)
		PRINT 50,TSM,X2,Y1
		Y1=Y(X3)
		PRINT 50,TSM,X3,Y1
		IF(I.EQ.N)CALL EXIT
		I=I+1
		GO TO 35
		END

V.B

2. a.) correct
   b.) types

3. real

ANSWERS

V.C 1.

FORTRAN CODING FORM

C for Comment

Statement No (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		FUNCTION SUMPD(A,B,N)	
		DIMENSION A(1000),B(1000)	
		SUMPD=0.0	
		DO 10 I=1,N	
		SUMPD=SUMPD+A(I)*B(I)	
10		CONTINUE	
		RETURN	
		END	

2. COMPLEX FUNCTION CPROD (B, C)

3. COMPLEX CPROD

4. four

5. integer

6. actual parameter

V.D 1.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		SUBROUTINE PRNT(K)	
		IF(K.NE.0) RETURN	
		PRINT 50	
50		FORMAT(6H K = 0)	
		RETURN	
		END	

2. CALL PRNT (M)

Note that in the calling sequence (that is, the list of parameters) the naming of variables need not be identical in the main program and subroutine, but should be consistent in type, and position.

ANSWERS

V.D 3.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		SUBROUTINE PICK (LIST, LEAST)	
		DIMENSION LIST(50)	
		LEAST=LIST(1)	
		DO 10 I=2,50	
		IF (LIST(I)-LEAST) 5,10,10	
5		LEAST=LIST(I)	
10		CONTINUE	
		RETURN	
		END	

V.E

1. a.) -2
   b.) 25
   c.) -3

2. 2, X, minimum, Y, Z

3. a.) 2.0
   b.) -5.0
   c.) 3.0
   d.) 1.0
   e.) 0.0
   f.) 2.0

4.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		BETA = AMOD(ALPHA,360.0)	

5. 0

6. C

ANSWERS

V.E 7. 3.7, 5.5

8. radians

9.

FORTRAN CODING FORM

C for Comment

	Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
a.)			Y= TAN(X)	
b.)			Z = ABS (SIN(X) - COS (X))	
	or		Z = ABS (COS (X) - SIN (X))	
c.)			Y=ALOG (X)	
d.)			Z=SQRT(X) + SQRT (Y)	
e.)			Y=ATAN2 (A , B)	

10. a.) 0.0
b.) 1.0
c.) -1.0
d.) 1.0

V. F

1. . . . is given a name which identifies the block

2. A block name (CEMENT) and subprogram name (CEMENT) may not be the same.

ANSWERS

V.G 1. Yes

2.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		BLOCK DATA	
		COMMON/ZZ/SLEEP(10),HRS	
		DATA(SLEEP(I),I=1,10),HRS/1.5,2.0,	
	1	10.9,3*5.7,4*9.8,8.5/	
		END	

V.H

1. EQUIVALENCE

2. EQUIVALENCE (A, B, I)

3. DIMENSION C(10)
   EQUIVALENCE (F, C(5))

4. F(2) with C(6); F(3) with C(7)

5. EQUIVALENCE (X, F), (F(2), UNREAL)

6. a. Can't EQUIVALENCE variables in the same COMMON.
   b. Shouldn't extend COMMON.
   c. Can't EQUIVALENCE variables in different COMMON areas.
   d. Arrays E and F are inconsistently equivalenced.

ANSWERS

V.I

1. EXTERNAL

2. Preceding

3. EXTERNAL SIN, COS
   TT = TAN1(SIN(THETA), COS(THETA))

V.J

1. a.) Statement function
   b.) Function subprogram
   c.) Subroutine subprogram

2. a.) In the program where it is to be used.
   b.) By placing the statement function name in an arithmetic or logical expression.

3. a.) 60, 1
   b.) formal parameters, simple variables

4. a.) type of variable, fixed or floating point b.) type

5. Subscripted variables are dimensioned and function names are not.

6. a.) CALC (X, Y, Z) = (X +Y + Z)/9.3

7. function, subroutine

8. a.) True. b.) False. The naming of the parameters need not be the same, but their ordering in the list and type must be.

9. Yes

10. CALL NAME (p_1, p_2, . . ., p_n)

    $60 \geq n \geq 0$

ANSWERS

V. J

11. False. Ordering is the most important factor. Variable names may or may not be the same.

12. a.) blank common, labeled common
    b.) name
    c.) variable name
    subprogram

13. a.) Variable A is defined in both COMMON statements.
    b.) The block name begins with a number, but is not all numbers.
    c.) Variable ARRAY is dimensioned twice.
    d.) No errors

14. In DIMENSION statements within a subprogram, the main program furnishing the values through the calling sequence.

15. a.) The deck of cards must be submitted with each computer run.
    b.) Requires excessive computer memory and time.

16. Variables defined in the block data subprogram must be in labeled common.

17. Computations

ANSWERS

VI.A

1. Double precision with exponent

2. Ew.d

3. 322

ANSWERS

VI. B

1. Fw.d and Ew.d

2. When the magnitude of the number exceeds the range for F-type conversion

3. bb1.273E+03

4. bbbb1273.bbbb

5. *773E+06

6.

Format Type	Output	
a.) E	bbbb1.2E+04	
b.) E	b1.2346E+04	(rounding has occurred)
c.) E	bbbbbb1E+04	
d.) F	bb12345.7bbbb	
e.) E	bbb1.2E+04	

VI. C

1. Logical

2. A = true
   B = false
   C = true
   D = true

3. bbbbbTbbbbbbbbbFbF

4. bbbTbbbFbbbF

5. bbbTbbbFbbbT

ANSWERS

VI.D

1. 6.88

2. none

3. 4

FORTRAN CODING FORM

C for Comment

Statement No (1–5)	Cont. (7)	FORTRAN STATEMENT (7–50)	(73–80)
		COUNT ANGLE	
		101 -1.354000E-03	
		102 -2.986238 0E-01	
		103 5.472547 3E+00	
		104 1.796328 7E+01	
		105 1.012013 3E+02	

ANSWERS

VI. F

1. Alphanumeric

2. CDC 6000 series console display code

3. 10

4. TESTbDATAb

5. HEAD1 = TESTbDATAb
   HEAD2 = RESULTSbbb

6. HEAD1 = TESTbDATAb
   HEAD2 = RESULTSbbb

7. HEAD1 = TESTbDAbbb

VI.G

1. DECEMBERb25,b1967

2. DEC,b1967

3. DECb25

ANSWERS

VI.H

1. Alphanumeric

2. DATE = 34354634334641425555
   STATN = 23240124111716553437
   TEMP = 00000000000000003534

3. DATE = 34354634334641425555
   HEDNG1 = 55552324012411171655
   STANO = 00000000000000003437
   TEMP = 00000000000000003534
   HEDNG2 = 55040507220505235555

4. DATE = 00003435463433464142
   HEDNG1 = 55552324012411171655
   STANO = 34375555555555555555
   TEMP = 35345555555555555555
   HEDNG2 = 00005504050722050523

5. LATITUDEbbLONGITUDEbALTITUDEbb

6. LATLONGALT

ANSWERS

VI.I

1. Octal numbers

2. 20

3. C, D (Not octal numbers)

4. 5673244313

5. bbb22431777125673244313

6. OCT1 = 77777777777777765432
   OCT2 = 00000000000000000717
   OCT3 = 00000000000000212223

ANSWERS

VI. J 1.

C for Comment — FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
10		FORMAT (I10,I5,I7,2X,A7,3X,F6.3)	

2.

C for Comment — FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		DIMENSION FMT1(8)	
		READ 20, (FMT1(I),I=1,8)	
20		FORMAT(8A10)	

3. parenthesis

4.

C for Comment — FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		READ FMT1,N1,N2,N3,K,X	

VI. J
(Cont.)

5. a.) (10F12.6)
b.) (6F15.6)
c.) (7F15.6)
d.) (10F12.6/5F12.6)

ANSWERS

VI.K

1. console display code

   input

   memory

2.

```
      ENCODE(80,2,Z(1))X,Y,I,J
```

3. a.) 40
   b.) 4
   c.) bbb1.250bb
   d.) 00bbbbbbbb

4. VALUE: DATAbbbbbb
   H: 5.28
   I: 33

5.

```
      DECODE(20,5,Z)TYPE,N1,PI,N2
    5 FORMAT(A6,I4,F6.4,I4)
```

VI. L

1.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	73–80
		DIMENSION X(2000)	
		WRITE(7)(X(I), I=1,1000)	

2.

FORTRAN CODING FORM

C for Comment

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	73–80
		DIMENSION X(100)	
		DO 20 I=1,10	
		READ(7)(X(J), J=1,100)	
		IF(.NOT.(I.EQ.1 .OR. I.EQ.10))GO TO 20	
		WRITE(9)(X(J), J=1,100)	
20		CONTINUE	

ANSWERS

VI. M

1.

C for Comment — FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		REWIND 7	

2.

C for Comment — FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		IF(EOF,7)200,400	

3.

C for Comment — FORTRAN CODING FORM

Statement No. (1–5)	Cont.	FORTRAN STATEMENT (7–50)	(73–80)
		BACKSPACE 7	
		BACKSPACE 7	

VI.N

1.

```
$ALIST A=1.3,2.5,3*5.0,
B(2)=8.3,B(5)=.25,
K=5,3,0,$END
```

2.

```
      DIMENSION X(10),Y(5),Z(20)
      NAMELIST /XARRAY/X,Y,Z,K,B,L
      READ(5,XARRAY)
```

3.

```
      NAMELIST /TLIST/A,K,R
a.)   $TLIST A(3)=5.2,A(5)=6.0,$END
b.)   $TLIST A=4*0.0,$END
c.)   $TLIST A(4)=9.2,K=3,R=6.8,$
d.)   $TLIST A(1)=1.0,A(2)=1.0,A(3)=9.3,A(5)=5.5,
      K=7,$END
e.)   $TLIST $END
```

ANSWERS

VI. N. (Cont.) 4.

| | | |

VI. P

1. image

2. END

3. main, subprograms

4. executive (or system)

5. PROGRAM MAIN (INPUT, OUTPUT, TAPEIN, DATA)

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