

Student Manual

PART I: Introduction to BASIC

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INTRODUCTION TO BASIC

LESSON 1

THE TRS-80 MICROCOMPUTER

OVERVIEW

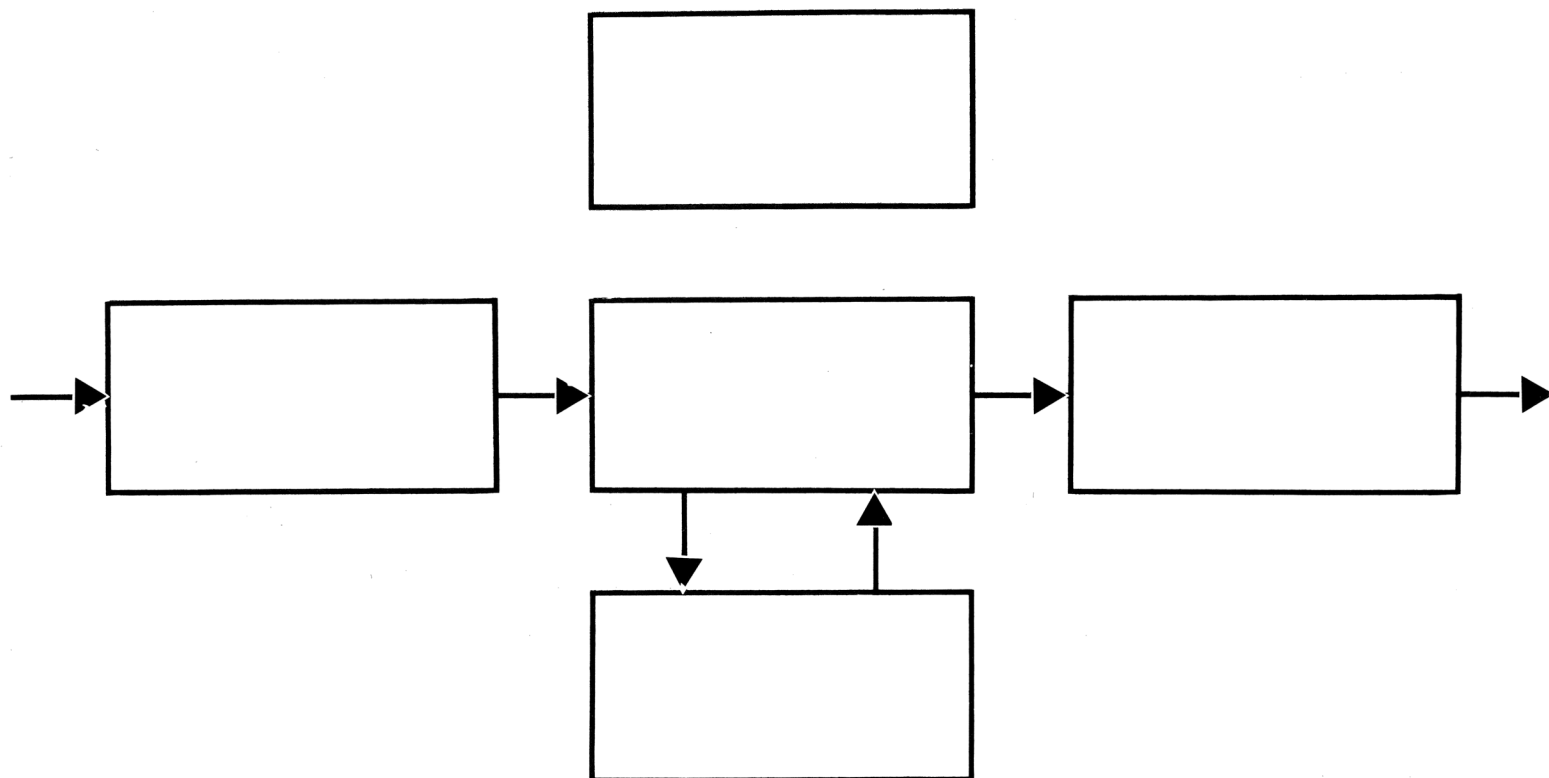
In this lesson you will be shown how to run a microcomputer. The microcomputer you will be using is the TRS-80. As part of this lesson you will see the TRS-80 operated and then have the opportunity to enter and run a BASIC program.

OBJECTIVES

By the time you have completed this lesson you will be able to:

1. Identify the basic components of the TRS-80 and relate them to the block diagram of a general purpose computer.
2. Explain the meaning of the following key terms: BASIC, BIT, BYTE, K, RAM, ROM.
3. Enter and run a BASIC program.

THE BLOCK DIAGRAM OF THE GENERAL PURPOSE COMPUTER



COMPONENTS OF THE TRS-80 MICROCOMPUTER



THE COMPONENTS EXPLAINED

1-3

INPUT with the TRS-80

PROCESSING with the TRS-80

TERMS USED TO DESCRIBE COMPUTER MEMORY

BIT _____

BYTE _____

K _____

R.A.M. _____

R.O.M. _____

MEMORY with the TRS-80

OUTPUT with the TRS-80

CONTROL in the TRS-80

B.A.S.I.C. _____

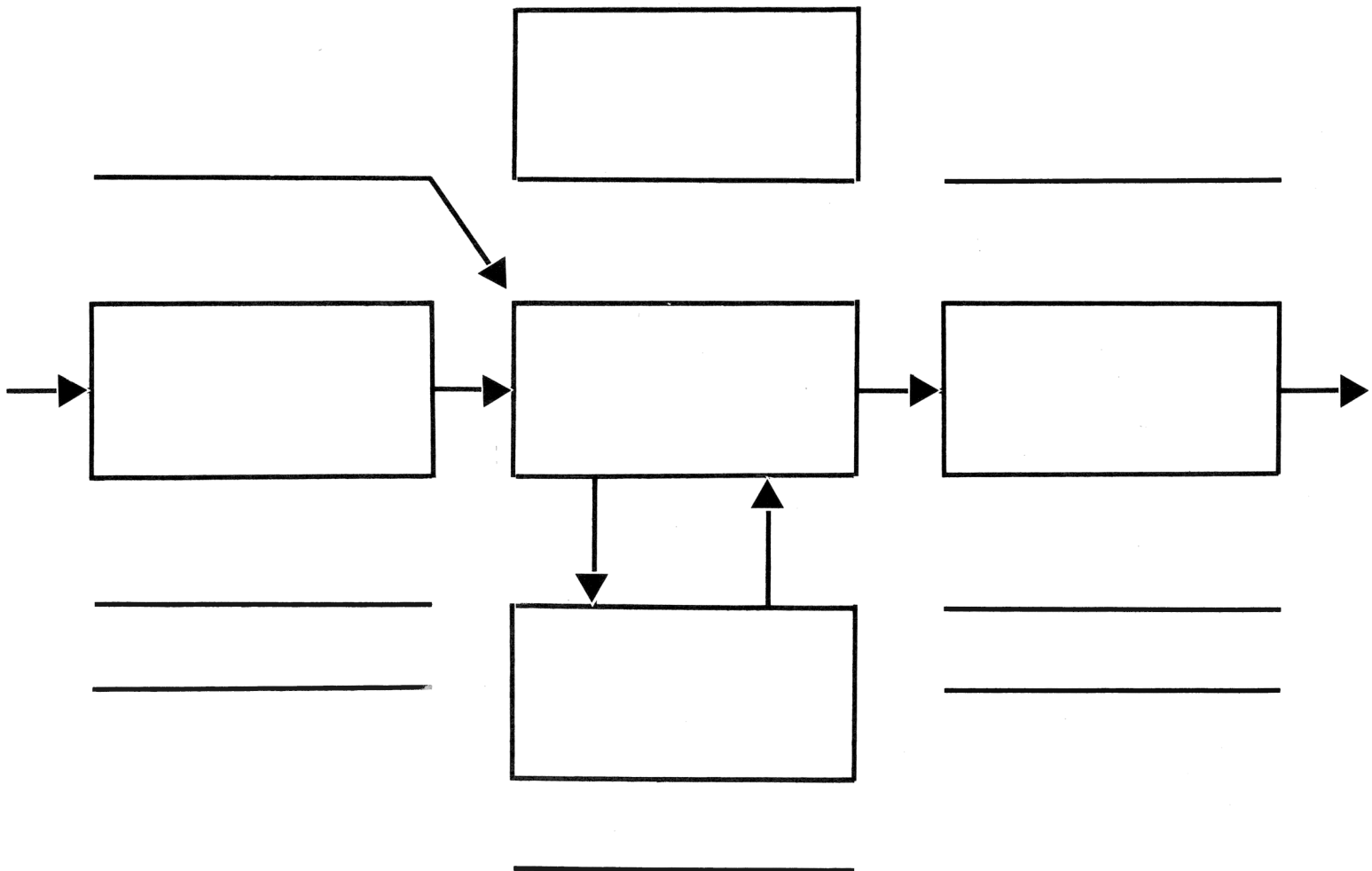
R.O.M. _____

EXAMPLE OF A BASIC PROGRAM

```
10 PRINT "A COUNTING PROGRAM"  
20 LET K=0  
30 LET K=K+1  
40 PRINT K  
50 GOTO 30
```

PROGRAM OUTPUT: _____

REVIEW: THE TRS-80 SYSTEM



QUICK QUIZ 1

DIRECTIONS: Using the answer sheet supplied, answer the following questions.

1. On the TRS-80, the input devices are the
 - A. keyboard and video monitor
 - B. cassette tape player and video monitor
 - C. keyboard and cassette tape player
 - D. cassette tape player and the power supply

2. That component of a general purpose computer which directs the activity of all other components is called
 - A. INPUT
 - B. CONTROL
 - C. MEMORY
 - D. OUTPUT

3. In order to enter data into the computer using the keyboard, the last key that must be pressed is
 - A. SPACE BAR
 - B. ENTER
 - C. BACKSPACE
 - D. SHIFT

4. In terms of the size of memory in computers, the letter K represents approximately _____ bytes.
 - A. 10
 - B. 100
 - C. 1000
 - D. 10,000

5. The output devices for the TRS-80 are the
 - A. keyboard and video monitor
 - B. keyboard and cassette tape player
 - C. cassette tape recorder and the memory
 - D. cassette tape recorder and video monitor

6. B.A.S.I.C. stands for
 - A. Basic Algorithmic System for Instructional Computing
 - B. Basic Advanced System for Interactive Computing
 - C. Beginners' Algebraic Symbolic Interactive Computing
 - D. Beginners' All-purpose Symbolic Instruction Code

7. In order to execute a program stored in the computer's memory, what word must be typed and entered?
 - A. LOAD
 - B. SAVE
 - C. RUN
 - D. EXECUTE

8. ROM stands for

- A. Read Only Memory
- B. Randomly Operated Memory
- C. Regulated Operational Machine
- D. Random Octal Machine

9. In this line of BASIC programming, what does the "20" stand for?
20 PRINT "COMPUTER TEST"

- | | |
|--------------|----------------|
| A. Statement | C. Variable |
| B. Text | D. Line Number |

10. PRINT, LET, GOTO are all examples of BASIC

- | | |
|---------------|--------------|
| A. orders | C. commands |
| B. statements | D. variables |

ACTIVITY 1

1. Follow these instructions to load and execute a BASIC program on the TRS-80:

- ☐ Turn on computer (switch in back, rightside, next to power cord.)
- ☐ Place cassette supplied by instructor in cassette player. (Rewind if necessary).
- ☐ Type CLOAD and press ENTER. Asterisks will be displayed after about 10-15 seconds blinking on the video display.
- ☐ Watch for READY to appear on the screen. When it does the tape player will automatically stop.
- ☐ Type RUN and press ENTER. The program will then run and you can follow the instructions on the screen.

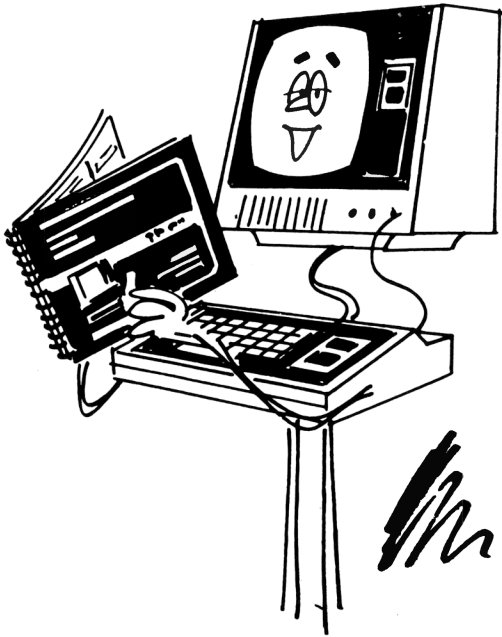
2. Follow these instructions for entering and running a program from the keyboard:

- ☐ Enter the following program at the keyboard. Remember to press ENTER after every line.

```
10 LET K=0
20 LET K=K+1
30 PRINT K
40 GOTO 20
```

- ☐ Run the program by typing RUN and pressing ENTER.
- ☐ After several moments press BREAK.
- ☐ Now type 40 IF K > 25 THEN 20. Press ENTER.
- ☐ Now type RUN and press ENTER.
- ☐ Now type 50 PRINT "THAT'S ALL, FOLKS" Press ENTER.
- ☐ Type RUN and press ENTER.

ANSWER SHEET FOR QUICK QUIZ 1



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON FIRST TRY

9 or 10

7 or 8

5 or 6

Below 5

COMMENT

GREAT JOB

PRETTY GOOD

NOT SO HOT

GET WITH IT!

INTRODUCTION TO BASIC

LESSON 2

INTRODUCTION TO THE BASIC LANGUAGE

OVERVIEW

In this lesson you will have explained the purpose of the BASIC computer language and how it functions in a computer system. In addition, you will have explained and illustrated a set of BASIC statements and commands which you will use to give directions to the computer. Again you will have the opportunity to run a program which has been previously written, and to write a program yourself.

OBJECTIVES

By the end of this lesson you will be able to:

1. Explain what is needed to communicate with the microprocessor.
2. Explain the purpose and use of the following BASIC statements: PRINT, LET, REM
3. Explain the purpose and use of the following BASIC commands: RUN, LIST, NEW
4. List the names of the three parts of a line of BASIC programming.

REVIEW

The TRS-80 MICROCOMPUTER SYSTEM



INPUT: _____

PROCESSING: _____

MEMORY: _____

OUTPUT: _____

CONTROL: _____

DEFINITIONS

BASIC _____

BIT _____

BYTE _____

RAM _____

ROM _____

HOW TO ENTER A LINE OF PROGRAMMING INTO THE
COMPUTER: _____

HOW TO CORRECT A TYPING MISTAKE: _____

PURPOSE OF THE BASIC LANGUAGE

COMPONENT	LANGUAGE SPOKEN AND UNDERSTOOD

The BASIC language acts as an _____. That is, it takes what you say and _____ it so the MICROPROCESSOR can understand it. In the same manner it takes what the _____ says and interprets it so that _____.

EXAMPLE OF A BASIC PROGRAM

This program will compute miles per gallon for a trip of 220 miles in which 4.3 gallons of fuel were used.

PROGRAM COMMAND

FUNCTION

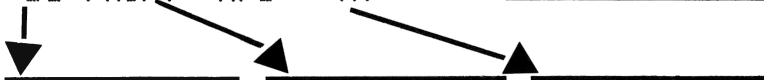
10 REM MPG COMPUTATION

20 LET D=220

30 LET G=4.3

40 LET M=D/G

50 PRINT "MPG =" ; M



EXPLANATION OF BASIC STATEMENTS

STATEMENT

PURPOSE

REM

LET

PRINT

EXPLANATION OF BASIC COMMANDS

COMMAND

PURPOSE

RUN

LIST

NEW

QUICK QUIZ 2

DIRECTIONS: Using the answer sheet, page 2-6, answer the following questions.

1. The BASIC language, operating in a computer system, acts as a(n)

A. microprocessor	C. interpreter
B. counter	D. extender
2. Information that you enter into the computer is changed by BASIC into a language that is understood by the

A. printer	C. tape machine
B. microprocessor	D. video screen
3. A microprocessor understands

A. bits	C. English
B. formulas	D. statements
4. The BASIC command used to run a program is

A. PRINT	C. LIST
B. NEW	D. RUN
5. The BASIC statement which is never seen when you run a program, but is there to help the programmer document the program, is

A. LET	C. PRINT
B. COMMENT	D. REM
6. To clear out memory of any program which may be stored there, the command to use is

A. NEW	C. RUN
B. HALT	D. PRINT
7. In BASIC, RUN, NEW and LIST are called

A. statements	C. commands
B. directors	D. orders

8. If you wished to set C equal to 100, which statement would you use?
- | | |
|----------|---------|
| A. LET | C. GOTO |
| B. PRINT | D. LIST |
9. In the TRS-80 system, the cassette tape *player* functions as
- | | |
|---------------|------------|
| A. INPUT | C. OUTPUT |
| B. PROCESSING | D. CONTROL |
10. The kind of computer memory which has the BASIC language entered permanently is called
- | | |
|---------|--------------|
| A. ROM | C. RAM |
| B. CORE | D. AUXILIARY |

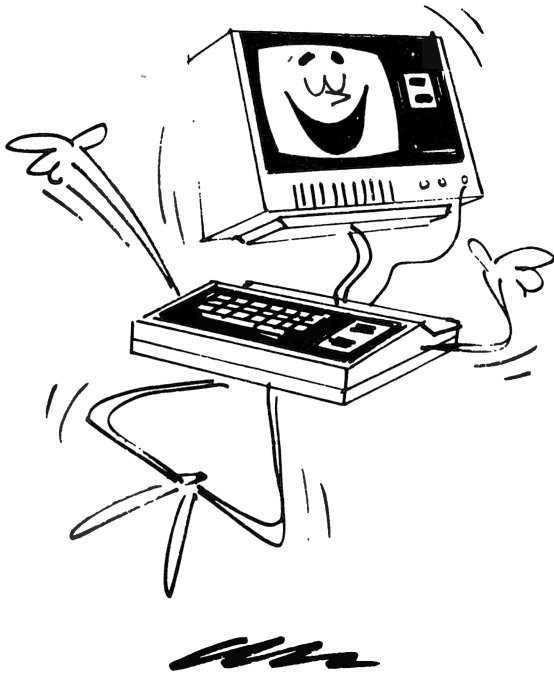
ACTIVITY 2

1. Enter and run the following program.

```
10 REM MPH COMPUTATION
20 LET D= 442
30 LET T= 8.5
40 PRINT "MPH =" ;D/T
```

2. Using the statements REM, LET, and PRINT, write, enter, and run a program to compute gallons per hour used for a trip of 442 miles which took 21.25 gallons and lasted 8.5 hours
- * 3. Write, enter, and run a program to compute MPG and MPH for a trip of 1092 miles which took 21 hours and used 56.1 gallons of fuel.

ANSWER SHEET FOR QUICK QUIZ 2



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON FIRST TRY

9 or 10

7 or 8

5 or 6

Below 5

COMMENT

TERRIFIC!

GOOD

OK

TRY HARDER, OK?

FEEDBACK FOR ACTIVITY 2 IS IN THE BACK OF THE STUDENT MANUAL.

INTRODUCTION TO BASIC

LESSON 3

ARITHMETIC IN BASIC

OVERVIEW

This lesson presents the uses of the basic arithmetic operations — addition, subtraction, multiplication, and division. In using these arithmetic operators you will be shown the order of operations followed by BASIC in running statements which include several different kinds of arithmetic operators. In addition, you will be shown how to write BASIC programs, including the uses of line numbers, statements, and arguments. Again you will have the opportunity to write, enter, and run several programs.

OBJECTIVES

By the time you have completed this lesson, you will be able to:

1. Explain how to use BASIC to add, subtract, multiply, and divide.
2. Explain the order of operations in BASIC, according to the M.D.A.S. rule.
3. Describe how the computer follows the program.

REVIEW

B.A.S.I.C. stands for:

B _____ A _____ S _____ I _____ C _____

REVIEW (Continued)

The purpose of the BASIC language is to _____

BASIC STATEMENTS

STATEMENT

PURPOSE

BASIC COMMANDS

COMMAND

PURPOSE

ARITHMETIC OPERATIONS

OPERATION

SYMBOL

EXAMPLE

ARITHMETIC OPERATIONS (Continued)

EXAMPLE BASIC PROGRAM USING ARITHMETIC OPERATIONS:

```

10 REM DISTANCE EQUALS RATE TIMES TIME
20 LET R= 52
30 LET T= 3
40 LET D= R*T
50 PRINT "DISTANCE =" ;D

```

THE LINE WHICH USES AN ARITHMETIC OPERATOR IS _____

THE OPERATION USED IS _____

ORDER OF OPERATIONS:

M _____ D _____ A _____ S _____

HOW TO REMEMBER:

M _____ D _____ A _____ S _____

APPLICATION OF M.D.A.S.

$$3 + 10 - 2 \times 14 \div 7 =$$

$$3 + 10 - \underline{\hspace{2cm}} \div 7 =$$

$$3 + 10 - \underline{\hspace{2cm}} =$$

$$\underline{\hspace{2cm}} - \underline{\hspace{2cm}} =$$

THEREFORE $3 + 10 - 2 \times 14 \div 7 = \underline{\hspace{2cm}}$

BASIC STATEMENTS

STUDY THIS PROGRAM:

```

10 REM TWO ARITHMETIC OPERATIONS (+ AND *)
20 LET A=2
30 LET B=3
40 LET C=4
50 PRINT A+B+C, A*B*C

```

RECALL THAT EACH PROGRAM LINE HAS THREE PARTS. WHAT ARE THEY?

_____, _____, _____

BASIC STATEMENTS (Continued)

LINE NUMBERS

1. The computer follows the program, one line at a time, according to the line number.
 2. In BASIC, it is customary to number the lines by "tens," but any integers may be used. Remember, the computer follows the program _____
-

QUICK QUIZ 3

DIRECTIONS: Use the answer sheet and answer the following questions.

1. In BASIC the plus sign (+) is used for addition. Which of the following is used for multiplication?

A. ×	C.
B. *	D. **

2. In this problem, which operation would be done first by BASIC?

$$5 + 15 - 3 \times 28 \div 14$$

A. $5 + 15$	C. 3×28
B. $15 - 3$	D. $28 \div 14$

3. In this problem what would be the last operation?

$$5 \times 50 \div 25 + 3$$

A. $10 + 3$	C. 5×50
B. $50 \div 25$	D. $25 + 3$

4. The first part of any line of a BASIC program is the _____

A. line number	C. command
B. statement	D. argument

5. In the following BASIC program line, what is PRINT

50 PRINT "SPEED = ":R

A. line identifier	C. statement
B. command	D. argument

6. A command used outside of the program is called a _____
- | | |
|--------------|-------------|
| A. statement | C. computer |
| B. line | D. command |
7. It is customary in BASIC to number the lines by
- | | |
|---------|-------------|
| A. ones | C. tens |
| B. twos | D. twenties |
8. The program executes the statements in _____ order.
- | | |
|--------------|---------------|
| A. ascending | C. descending |
| B. random | D. entry |
9. Which of the following statements is ignored in the execution of a BASIC program?
- | | |
|---------|----------|
| A. LET | C. REM |
| B. GOTO | D. PRINT |
10. If you wished to clear memory, which BASIC command would you use?
- | | |
|----------|--------|
| A. CLEAR | C. NEW |
| B. LIST | D. END |

ACTIVITY 3

1. Enter and execute the following BASIC program:

```

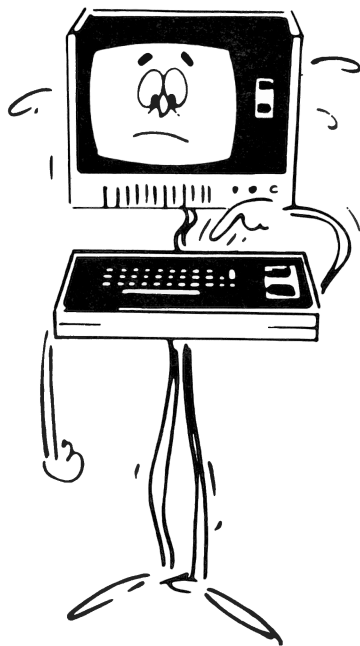
10 REM GALLON TO LITER CONV.
20 G = 10.5
30 L = G * 3.785
40 PRINT G; "GALLONS = "; L; "LITERS"

```

2. Write, enter, and run a program to compute miles per liter for a trip covering 402 miles using 20.1 gallons of fuel.

- * 3. Write, enter, and run a program to compute kilometers per liter for a trip covering 330 miles using 14.8 gallons of fuel. (1 mile = 1.609 kilometers)

ANSWER SHEET FOR QUICK QUIZ 3



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER RIGHT ON FIRST TRY

9 or 10

7 or 8

5 or 6

Below 5

COMMENT

SUPER

GOOD GOING

O.K.

TRY HARDER, O.K.?

FEEDBACK TO ACTIVITY 3, PROBLEMS 2 AND 3 IS IN THE BACK OF THE STUDENT MANUAL.

INTRODUCTION TO BASIC LESSON 4 DEVELOPING AND STORING PROGRAMS

OVERVIEW

This lesson will provide helpful information on two topics: developing your own programs and using the tape recorder for storing your programs for future use. Included in the discussion of program development will be an explanation of several common errors made by programmers and some of the errors that can be detected by the computer. As a part of this lesson you will write, enter, store, and retrieve a program.

OBJECTIVES

By the end of this lesson you will be able to:

1. List the steps to follow in developing a computer program.
2. Explain what is meant by a "logical error."
3. Explain two common computer-detected errors and indicate how each is to be corrected.
4. Use the tape recorder as an input-output device for the TRS-80.

REVIEW

What is the M.D.A.S. Rule? _____

What does M.D.A.S. mean? _____

REVIEW (Continued)

Using the M.D.A.S. Rule, compute the value of each of the following problems:

$$4 + 3 \times 6 \div 9 - 1 = \underline{\hspace{2cm}}$$

$$10 + 4 \div 2 \times 9 - 8 = \underline{\hspace{2cm}}$$

DEVELOPING A COMPUTER PROGRAM

Suppose you wish to write a computer program to generate the first ten even integers (2, 4, 6, 8, 10, 12, 14, 16, 18, and 20) and then compute their sum.

The first thing you must do to develop your program is to

STEP 1: _____

STEP 2: _____

Possible Solution: Develop a program to generate the even integers 2 through 20 and, as each number is generated, direct the program to keep a running sum. After the final number has been generated and added to the running sum, print the total. Print all numbers in a column with a line between them and their sum.

STEP 3: _____

Example program:

```
10 K=0
20 K=K+2
30 PRINT K
40 S=S+K
50 IF K<20 THEN 20
60 PRINT "-----"
70 PRINT S
```

STEP 4: _____

What would be a good way to test this program? _____

Debug means _____

TYPES OF PROGRAMMING ERRORS

LOGICAL ERRORS

Definition: _____

Example:

```
10 REM DISTANCE COMPUTATION
20 R=20
30 T=3
40 PRINT "DISTANCE ="; R/T
```

Error: _____

Correction: _____

Note: Computer does *not* detect logical errors.

COMPUTER-DETECTED ERRORS

Definition: Errors made in having program ask computer to do something it cannot do.

Example 1:

```
10 REM COUNTING PROGRAM
20 K=0
30 K=K+1
40 PRINT K
50 IF K<20 THEN 25
```

Computer response: _____

Problem/Solution: _____

Example 2:

```
10 REM COUNTING PROGRAM
20 FOR I=1 TO 10
30 PRINT I
40 NEXT J
```

Computer response: _____

Problem/Solution: _____

THE TAPE RECORDER AS AN OUTPUT DEVICE

To save a program from memory:

- ☐ Place blank tape, wound past leader, in recorder.
- ☐ Set volume at _____.
- ☐ Press _____ and _____ buttons on recorder.
- ☐ Type _____ and press ENTER.
- ☐ When program is saved, _____.
- ☐ To check the tape, _____.

THE TAPE RECORDER AS AN INPUT DEVICE

To load a program from tape into memory:

- ☐ Place program tape in player, rewind if necessary.
- ☐ Set volume at _____.
- ☐ Type _____ and press ENTER.
- ☐ You will see two asterisks on the screen, one flashing _____
_____.
- ☐ When program is loaded, computer reports _____.

QUICK QUIZ 4

Directions: Using the answer sheet, respond to the following questions.

1. The first step to be done in developing a computer program is to

A. define the problem	C. test and debug the program
B. write and enter the program	D. outline the solution
2. After defining the problem the next step is to

A. debug the program	C. test the program
B. enter the program	D. outline the solution
3. "Debugging" a program means to

A. enter the program	C. correct mistakes
B. write BASIC statements	D. outline the solution

4. A good way to test a program is to
- A. read it through carefully.
 - B. compare its output with a known correct output.
 - C. read it through to another person.
 - D. compare it to a program that runs.
5. If in computing the sum of the two variables named A and B, the programmer writes and enters the following line, what type of error has been made?
- 5Ø PRINT "SUM = ";A-B
- A. logical
 - B. grammatical
 - C. syntax
 - D. computer-detected
6. A "logical error" will be _____ by the computer.
- A. detected
 - B. ignored
 - C. corrected
 - D. interpreted
7. Trying to branch to a line which is not part of the program will result in the computer
- A. stopping the program and reporting the error.
 - B. ignoring such an illogical error.
 - C. running through the entire program.
 - D. outputting an incorrect answer.
8. The command used to retrieve a program stored on a cassette tape is
- A. READ
 - B. PRINT
 - C. LOAD
 - D. CLOAD
9. When saving a program on a cassette tape, the tape machine acts as a
- A. player
 - B. recorder
 - C. player/recorder
 - D. all of the above
10. That part of the cassette tape which is transparent and cannot be used for recording a program is called the
- A. write-protect tab
 - B. spool
 - C. leader
 - D. recording feature

ACTIVITY 4

1. Enter and debug the following program. The desired output of the program is listed to the right.

PROGRAM

OUTPUT

```

10 REM SUM OF ODD INTEGERS 1-21
20 K=1
30 S=0
40 PRINT K
50 S=S-K
60 K=K+1
70 IF K<15 THEN 20
80 PRINT "-----"
90 PRINT K

```

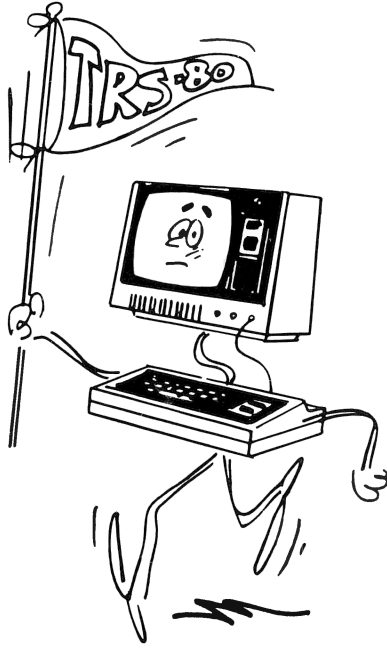
```

1
3
5
7
9
11
13
15
17
19
21
-----
121

```

2. Using the tape machine, save your correct version of the program. Then follow the procedures given to make certain your program has been saved correctly.

ANSWER SHEET FOR QUICK QUIZ 4



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON FIRST TRY

9 or 10

7 or 8

5 or 6

Below 5

COMMENT

GREAT WORK

PRETTY GOOD

FAIR

STUDY HARDER NEXT TIME

FEEDBACK FOR ACTIVITY 4, PROBLEM 1 IS IN THE BACK OF THE STUDENT MANUAL.

INTRODUCTION TO BASIC

LESSON 5

BRANCHING STATEMENTS

OVERVIEW

This lesson on BASIC introduces two statements that are used to control the flow of program execution. The first is called the unconditional branch and uses the GOTO statement. The second is the conditional branch, using the IF-THEN statement. Examples of each method will be presented and you will have the opportunity to write a program using these statements.

OBJECTIVES

By the time you have completed this lesson, you will be able to:

1. Explain what is meant by unconditional and conditional branching.
2. Explain the functions of and give examples of the BASIC statements GOTO and IF-THEN.
3. Write programs using unconditional and conditional branching.

REVIEW

THE FOUR STEPS TO BE FOLLOWED IN DEVELOPING A PROGRAM ARE:

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

TWO GENERAL TYPES OF PROGRAMMING ERRORS ARE:

1. _____
2. _____

THE UNCONDITIONAL BRANCH

Study this program, identify the function of each statement, and then see if you can predict the output.

PROGRAM STATEMENT

FUNCTION

10 LET K=0

20 LET K=K+1

30 PRINT K

40 GOTO 20

What is the output of this program? _____

DEFINITION OF THE GOTO STATEMENT

The statement called GOTO is known as an _____ branching statement. Whenever it is encountered in a program, the control of the program is transferred to the _____. In the BASIC statement, 20 GOTO 260, the computer follows the instructions given in line _____.

THE CONDITIONAL BRANCH

Study this program, identify the function of each statement, and then see if you can predict the output.

PROGRAM STATEMENT

FUNCTION

10 LET K=0

20 LET K=K+1

30 PRINT K

40 IF K<10 THEN 20

What is the output of this program? _____

DEFINITION OF THE IF-THEN STATEMENT

The IF-THEN statement is known as a _____ statement. The program will branch to the line named if it meets the _____.

NOTE: If the conditions of the branch cannot be met, then the program simply continues to the _____.

Study this program, again identifying the function of each line and predicting the output.

PROGRAM STATEMENT

FUNCTION

10 LET K=0

20 LET K=K+2

30 PRINT K

40 IF K<10 THEN 20

50 PRINT "ALL DONE"

Predicted output: _____

Complete the statement for this program which counts to 30 by 3's.

10 LET K= _____

20 LET K= _____

30 PRINT _____

40 IF _____

50 PRINT "THAT'S ALL, FOLKS"

SUMMARY

What is the difference between an unconditional branch and a conditional branch? _____

The statement to be used for the unconditional branch is _____ and for the conditional branch, _____.

QUICK QUIZ 5

DIRECTIONS: Using the answer sheet, answer the following questions.

1. Which statement is used for the unconditional branch?

- | | |
|------------|-----------------|
| A. IF-THEN | C. GOTO |
| B. IF-GOTO | D. IF-THEN-GOTO |

2. The branch which uses the IF-THEN statement is called a(n) _____ branch.

- | | |
|------------------|-------------|
| A. conditional | C. limited |
| B. unconditional | D. directed |

STUDY THE FOLLOWING PROGRAM AND THEN ANSWER QUESTIONS 3, 4, AND 5:

```
10 LET K=0
20 LET K=K+5
30 PRINT K
40 GOTO 20
```

3. Line 40 is an example of a(n) _____ branch.

- | | |
|----------------|------------------|
| A. conditional | C. continuous |
| B. directed | D. unconditional |

4. Which of the following is true of lines 10 and 20?

- A. Both lines are remark statements used to remind the programmer of what the program is designed to accomplish.
- B. As a result of both of these lines the value of K will repeatedly change from 0 to 5.
- C. In both of the lines, the LET command could be omitted.
- D. Errors exist in both lines.

5. If in line 40, the "20" were changed to read "10", what would be the output?

- | | |
|--------------------------|---------------------------------|
| A. An endless set of 5's | C. Nothing but blank lines |
| B. An endless set of 0's | D. A report of a "BRANCH ERROR" |

STUDY THE FOLLOWING PROGRAM AND THEN ANSWER QUESTIONS 6 AND 7:

```
10 LET K=0
20 LET K=K+4
30 PRINT K
40 IF K<40 THEN 20
50 PRINT "COUNTING COMPLETE"
```

6. Line 40 is an example of a(n)

- | | |
|------------------------------|--------------------------------|
| A. Print statement | C. Directed alteration |
| B. Conditional branch | D. Unconditional branch |

7. What line will be executed only when K=40?

- | | |
|--------------|--------------|
| A. 20 | C. 40 |
| B. 30 | D. 50 |

8. If the conditions of a branch cannot be met, the convention in BASIC is to

- A. report branch error**
- B. try the branch once more**
- C. fall through to the next line and execute it**
- D. halt the program execution, since the line cannot be executed**

9. The phrase "K<20" is to be read

- A. "K LESS THAN 20"**
- B. "K LESS THAN OR EQUAL TO 20"**
- C. "K GREATER THAN OR EQUAL TO 20"**
- D. "K NOT EQUAL TO 20"**

10. To print output to the video display, the command PRINT is used and

- A. all data to be output must be enclosed in brackets.**
- B. literal data to be enclosed in parentheses.**
- C. literal data to be enclosed in double quotes.**
- D. single quotes to be placed around numeric output.**

ACTIVITY 5

1. Study this BASIC program, identifying those statements which will and will not be executed. Then write the message which would appear if this program were executed.

```

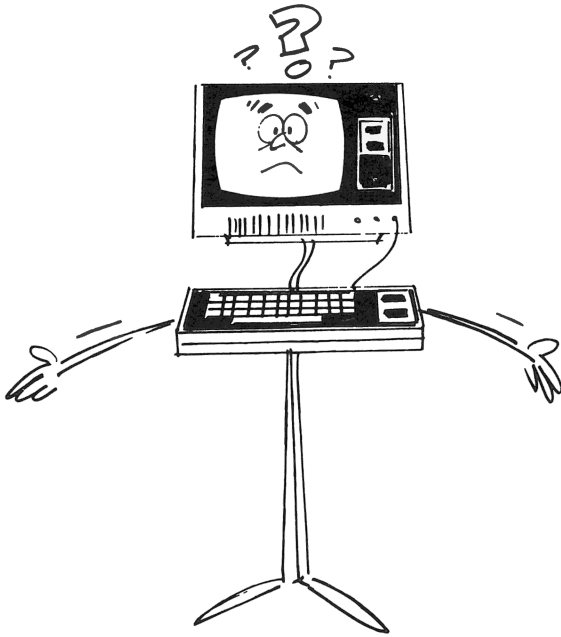
10 PRINT "THE 'GOTO' STATEMENT IS USED "
20 GOTO 110
30 PRINT "THE TRS-80 IS A GREAT MICROCOMPUTER "
40 PRINT "REDIRECT THE ORDER OF EXECUTION "
50 GOTO 180
60 PRINT "PRINT STATEMENTS CAUSE PRINTING "
70 PRINT "TO TAKE PLACE ON THE VIDEO DISPLAY "
80 GOTO 20
90 PRINT "CAUSE THE PROGRAM TO JUMP FORWARD "
100 GOTO 130
110 PRINT "TO "
120 GOTO 40
130 PRINT "OR BACKWARD "
140 GOTO 200
150 PRINT "THE 'GOTO' STATEMENT IS POWERFUL "
160 PRINT "SINCE IT IS USED TO MODIFY PROGRAM FLOW"
170 GOTO 150
180 PRINT "USING 'GOTO' WILL ALLOW YOU TO "
190 GOTO 90
200 END

```

THE MESSAGE: _____

2. Using the statements REM, LET, PRINT, and IF-THEN, write a program to count to 25 by 5's and report ALL DONE when 25 has been reached.

ANSWER SHEET FOR QUICK QUIZ 5



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER RIGHT ON FIRST TRY

9 or 10

7 or 8

5 or 6

Below 5

COMMENT

THAT'S REALLY GREAT

PRETTY GOOD

JUST O.K.

HOW ABOUT TRYING HARDER?

FEEDBACK TO ACTIVITY 5, PROBLEM 2 IS IN THE BACK OF THE STUDENT MANUAL.

INTRODUCTION TO BASIC

LESSON 6

LOOPING

6-1

OVERVIEW

This lesson presents a new BASIC statement which lets you cause the program to loop. The statement, FOR-NEXT-STEP, lets you tell how many times any set of steps is to be executed, or looped through. In addition, you will be shown how to enter data from the keyboard using the INPUT statement. Two types of data, numeric and literal, can be entered using INPUT. Again, you will do some programming of your own on the system.

OBJECTIVES

By the time you have completed the study of this lesson, you will be able to:

1. Explain what looping means.
2. State the purpose of the FOR-NEXT-STEP statement and illustrate its use.
3. Explain the INPUT statement, including its use with two types of variables.

REVIEW

BASIC COMMANDS

Purpose: _____

Examples: _____

REVIEW (Continued)

BASIC STATEMENTS

Purpose: _____

Examples: _____

FOR-NEXT-STEP STATEMENT

Recall this "counting" program:

```
10 K=0
20 K=K+1
30 PRINT K
40 IF K<10 THEN 20
```

What is the output of this program? _____

Now study this program. The output is exactly the same as the previous counting program, the integers 1 to 10 in a column.

```
10 FOR K=1 TO 10
20 PRINT K
30 NEXT K
```

Which statement controls the number of integers printed? _____

Now look at this program:

```
10 FOR K=2 TO 20 STEP 2
20 PRINT K
30 NEXT K
```

The output is a column of even integers from 2 to 20. Why are only the even integers printed? _____

FOR-NEXT-STEP (Continued)

What is the function of the FOR-NEXT statement? _____

What does STEP do? _____

THE INPUT STATEMENT

Study this version of the “counting” program:

```
10 PRINT "WHERE SHOULD THE COUNTING START";  
20 INPUT K  
30 PRINT K  
40 K=K+1  
50 GOTO 30
```

What is different in this program from previous counting programs? _____

Sample RUN of counting program using INPUT statement :

```
RUN  
WHERE SHOULD THE COUNTING START? 60  
  
60  
61  
62  
.  
.  
.
```

What controlled the starting number for the counting? _____

THE INPUT STATEMENT (Continued)

Study this program to find new programming ideas:

```

10 REM COUNTING PROGRAM
20 PRINT "HOW HIGH SHOULD I COUNT";
30 INPUT H
40 PRINT "WHAT SHOULD I SAY WHEN I'M DONE";
50 INPUT A$
60 FOR K=1 TO H
70 PRINT K
80 NEXT K
90 PRINT A$

```

What things are different about this program? _____

SUMMARY

1. To input a numeric quantity, use _____ to identify the quantity.
2. To input a literal string, use _____ to identify the statement.

QUICK QUIZ 6

DIRECTIONS: Using the answer sheet, answer the following questions.

1. In order to control the number of times a specified set of statements is executed, the _____ statement may be used.

A. IF-NEXT
B. FOR-NEXT

C. FOR-GOTO
D. IF-END

2. If you wished to construct a program to count to 100, which of the following statements would be best to use?

A. 50 FOR K = 1 TO 100
60 PRINT K
70 NEXT K

C. 50 FOR K = 1 TO N
60 NEXT N
70 PRINT N

B. 50 LET K = 0
60 LET K = K + 100
70 PRINT K

D. 50 K = K + 1
60 PRINT K
70 GOTO 50

3. Which would be the best way to count from 3 to 30 by 3's?
- | | |
|----------------------|---------------------------|
| A. FOR K = 3 STEP 30 | C. FOR K = 1 TO 30 STEP 3 |
| B. FOR K = 30 STEP 3 | D. FOR K = 3 TO 30 STEP 3 |
4. In order to accept data from the keyboard during program execution, which statement should be used?
- | | |
|-------------|----------|
| A. PRINT | C. INPUT |
| B. FOR-NEXT | D. LIST |
5. The statement which allows the programmer to "document" the program is
- | | |
|---------|----------|
| A. REM | C. PRINT |
| B. LIST | D. COM |
6. In order to accept literal information from the keyboard, such as the statement, "THAT'S ALL FOLKS". which of the following lines of BASIC programming is best?
- | | |
|-----------------|-----------------|
| A. 30 INPUT A | C. 30 INPUT A\$ |
| B. 30 INPUT LIT | D. 30 PRINT A\$ |
7. If A\$ = "GOOD JOB", which of the following could be used to display A\$?
- | | |
|--------------|-------------|
| A. PRINT A | C. PRINT \$ |
| B. PRINT A\$ | D. LIST A\$ |
8. What character on the keyboard is used to tell the computer that literal information is being entered?
- | | |
|-------|------|
| A. \$ | C. ? |
| B. / | D. * |
9. If A\$ were set equal to "2 + 3", what would be the result of the statement PRINT A\$?
- | | |
|----------|------------|
| A. 2 + 3 | C. "2 + 3" |
| B. 5 | D. "5" |

10. Look at this short program:

```
10 PRINT "WHAT IS YOUR NAME";
20 INPUT A$
```

What will be the value of A\$ when the program is run?

- | |
|--|
| A. Whatever is entered at the keyboard |
| B. Nothing |
| C. "WHAT IS YOUR NAME" |
| D. Ø |

ACTIVITY 6

1. Explain the function of each statement in this program:

```
10 REM ADDING DRILL
20 PRINT "ADDING DRILL"
30 INPUT "WHAT IS YOUR NAME"; A$
40 PRINT "GLAD TO MEET YOU, "; A$
50 PRINT "WHAT IS 25+15 IN BASIC?"
60 INPUT A
70 IF A=40 THEN 100
80 PRINT "NOT IT, TRY AGAIN, "; A$
90 GOTO 50
100 PRINT "GREAT WORK, "; A$
```

10	_____
20	_____
30	_____
40	_____
50	_____
60	_____
70	_____
80	_____
90	_____
100	_____

NOTE: To check out your explanations, enter the program, run it, and see if it does what you think it should.

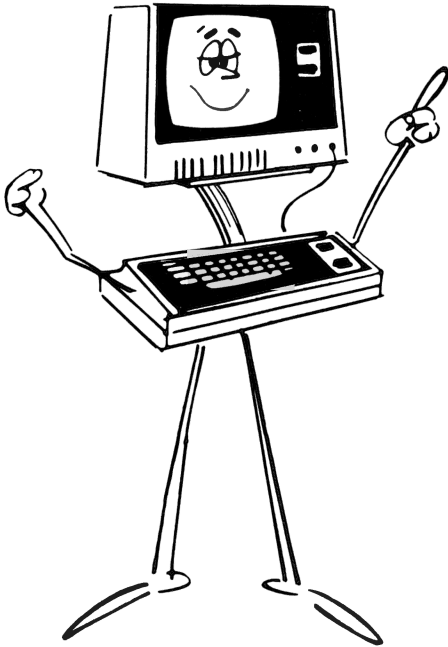
ACTIVITY 6 (Continued)

2. Using the BASIC statements FOR-NEXT and PRINT, write a program to list the numbers from 1 to 10. Then change the program so that it will “square” each of these numbers (that is, multiply them by themselves) and print the square next to the number. (NOTE: A PRINT statement can print more than one result on the same line by separating the results with commas.) Your output should appear as follows:

1	1
2	4
3	9
.	.
.	.
.	.

Check your program by entering and executing it.

ANSWER SHEET FOR QUICK QUIZ 6



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON FIRST TRY

10

9

8

7

Below 7

COMMENT

SUPER WORK

GOOD GOING

PRETTY GOOD

FAIR JOB

TRY A LITTLE HARDER, OK?

FEEDBACK, ACTIVITY 6, PROBLEM 2 IS IN THE BACK OF THE STUDENT MANUAL.

INTRODUCTION TO BASIC LESSON 7 GRAPHICS ON THE TRS-80

OVERVIEW

In this lesson you will be introduced to the use of some of the graphics capabilities of the TRS-80. Specifically you will be shown how to use the graphic statements SET, RESET, POINT, and CLS. Also as part of this graphics lesson you will learn how to use the two additional PRINT statements. As part of the Activity you will then develop programs for printing graphics using a variety of programming methods.

OBJECTIVES

By the time you have finished your study of this lesson on graphics, you will be able to:

1. Explain the use of and write programs with the four statements used in graphics: SET, RESET, POINT, CLS.
2. Explain the use of and write programs with two additional PRINT statements.
3. Explain the system used for selecting any point on the entire screen.
4. Create graphics on the TRS-80 video display.

REVIEW

WHAT IS THE FUNCTION OF THE FOR-NEXT-STEP STATEMENT? _____

WHAT DOES THE STEP PORTION OF THE STATEMENT DO? _____

REVIEW (Continued)

WHEN USING THE INPUT STATEMENT, IF A NUMERIC QUANTITY IS TO BE ACCEPTED, USE _____ TO IDENTIFY THAT QUANTITY.

IF A LITERAL (STRING) IS TO BE ACCEPTED, USE _____ TO IDENTIFY THE STRING.

GRAPHIC STATEMENTS

SET

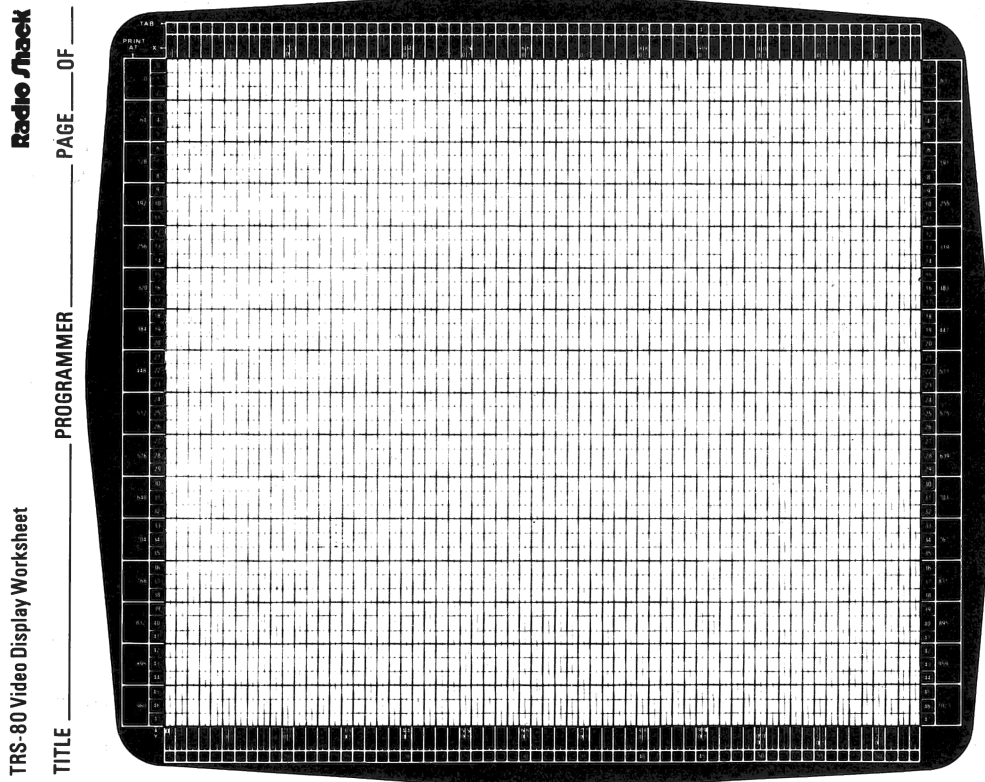
Example: SET (55, 32)

Defined: _____

RESET

Example: RESET (55, 32)

Defined: _____



Locate the cell identified by SET (55, 32). Use full size Video Worksheet at end of this chapter.

THE TRS-80 VIDEO DISPLAY WORKSHEET (Continued)

Study the Video Display Worksheet

Locate the X➤ at the top left of the worksheet.

The "X" numbers go from 0 to _____.

Locate the Y at the bottom left of the worksheet.

The "Y" numbers go from 0 to _____.

On your Video Display Worksheet locate the point determined by this program (note: CLS is used to clear the entire screen) use worksheet at end of chapter.

```
10 CLS
20 X=60
30 Y=25
40 SET(X,Y)
```

When executed, what will this program display on the CRT?

```
10 CLS
20 X=50
30 Y=10
40 SET (X,Y)
50 RESET(X,Y)
60 GOTO 40
```

Study this program and predict the output. (Hint: 0 to 127 includes all horizontal positions, 0 to 47 all vertical)

```
10 CLS
20 X=0
30 FOR Y=0 TO 47
40 SET(X,Y)
50 NEXT Y
60 X=X+1
70 IF X<128 THEN 30
```

Output: _____

THE POINT STATEMENT

Example: 50 IF POINT (10,10) = -1 THEN PRINT "10,10 LIGHTED"

Defined: _____

Predict the output of this program:

```
10 CLS
20 FOR I= 1 TO 20
30 SET (I,20)
40 NEXT I
50 IF POINT (20,20)= -1 THEN PRINT "20,20 LIGHTED"
60 IF POINT (30,30)= 0 THEN PRINT "30,30 NOT LIGHTED"
```

Output: _____

SUMMARY OF GRAPHIC STATEMENTS

Identify the function of each of the graphic statements:

CLS _____

SET _____

RESET _____

POINT _____

THE "PRINT TAB" STATEMENT

On the Video Display Worksheet, in the upper left corner, note the numbers next to TAB→. These numbers go from 0 to _____.

Study the following statement. What is the output?

```
10 PRINTTAB(30); "INDENTED 30 SPACES"
```

THE "PRINT ____" STATEMENT

Look again at the Video Display Worksheet. Notice in the upper left corner the words "PRINT AT:" Each row has a number at either end related to the PRINT ____ STATEMENT. For example, the numbers associated with the first row are 0 and 63. For the second row the numbers are _____.

THE "PRINT _____" STATEMENT (Continued)

Example of PRINT _____ statement: 10 PRINT _____ 400, "POSITION 400"

What would be the result of executing the above line?

SUMMARY OF PRINT TAB AND PRINT _____ STATEMENTS

Identify the function of each of the following commands:

PRINTTAB _____

PRINT _____

QUICK QUIZ 7

DIRECTIONS: Use the answer sheet and respond to these questions concerning graphics.

- Which statement is used to light a specific cell on the TRS-80 video monitor?

A. SET	C. POINT
B. RESET	D. CLS
- SET (20, 30) will light up a cell in the

A. 20th row, 30th column	C. 20th row, 20th column
B. 30th row, 20th column	D. 30th row, 30th column
- In the SET (X,Y) statement, the X represents the

A. vertical location	C. horizontal location
B. tab distance	D. "print at" location
- To turn any cell off, which statement is used?

A. SET	C. POINT
B. RESET	D. CLEAR
- If a cell, such as 40,40 is not lighted, and the command POINT (40,40) is executed, the value returned is

A. 0	C. -1
B. 1	D. 5
- Which of the following statements would be used if it were desired to print the word "GO" 40 spaces from the left side of the monitor?

A. PRINT "GO" (40)	C. PRINT (40) "GO"
B. PRINTTAB(40);	D. PRINTTAB(40); "GO"

For questions 7 through 10 refer to the following program listing:

```

10 CLS
20 FOR I=0 TO 127
30 SET(I,0)
40 NEXT I
50 FOR J=0 TO 47
60 SET(127,J)
70 NEXT J
80 FOR K=127 TO 0 STEP -1
90 SET (K,47)
100 NEXT K
110 FOR L=47 TO 0 STEP -1
120 SET (0,L)
130 NEXT L
140 FOR M=1 TO 1500
150 NEXT M

```

7. Lines 20 through 40 have which of the following functions?

- A. Draw a vertical line in the middle of the screen.
- B. Draw a horizontal line across the top of the screen.
- C. Light cell 1,127.
- D. Fill the entire screen.

8. Lines 50 through 70 have which of the following functions?

- A. Fill the entire screen from top to bottom.
- B. Draw a horizontal line in the middle of the screen.
- C. Draw a vertical line at the right side of the screen.
- D. Light cell 20,20.

9. Lines 80 through 100 draw a horizontal line

- A. from right to left across the bottom of the screen.
- B. in the middle of the screen.
- C. from left to right at the top of the screen.
- D. from left to right at the bottom of the screen.

10. What is the function of lines 140 through 150?

- A. To loop through a counter to "hold" screen display.
- B. To draw a line across the screen.
- C. To draw two lines from top to bottom on the screen.
- D. To clear the screen.

ACTIVITY 7

1. Enter the program listed at the top of this page and see if you can explain why it does what it does.
2. Using the same programming format, draw vertical lines on the left and right of the screen.

- * 3. The following program draws on the screen a block letter approximately 1 by 1½ inches. Enter the program and determine what letter is drawn. Then modify the program to draw at least three other letters.

```

10 CLS
20 FOR I=20 TO 35
30 FOR J=10 TO 20
40 SET (I, J)
50 NEXT J
60 NEXT I
70 FOR I=24 TO 35
80 FOR J=12 TO 18
90 RESET (I, J)
100 NEXT J
110 NEXT I

```

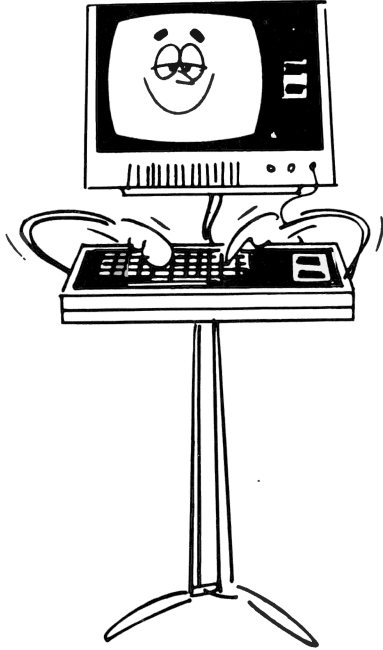
- * 4. Enter and execute the following program. Then see if you can explain why it does what it does.

```

10 FOR I= 1 TO 127 STEP( RND(3))
20 FOR J= 1 TO 47 STEP (RND(3))
30 SET(I,J)
40 NEXT J
50 NEXT I
60 FOR K=1 TO 600
70 NEXT K
80 CLS
90 GOTO10

```

ANSWER SHEET FOR QUICK QUIZ 7



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON FIRST TRY

10

8 or 9

6 or 7

Below 6

COMMENT

Super Job!!

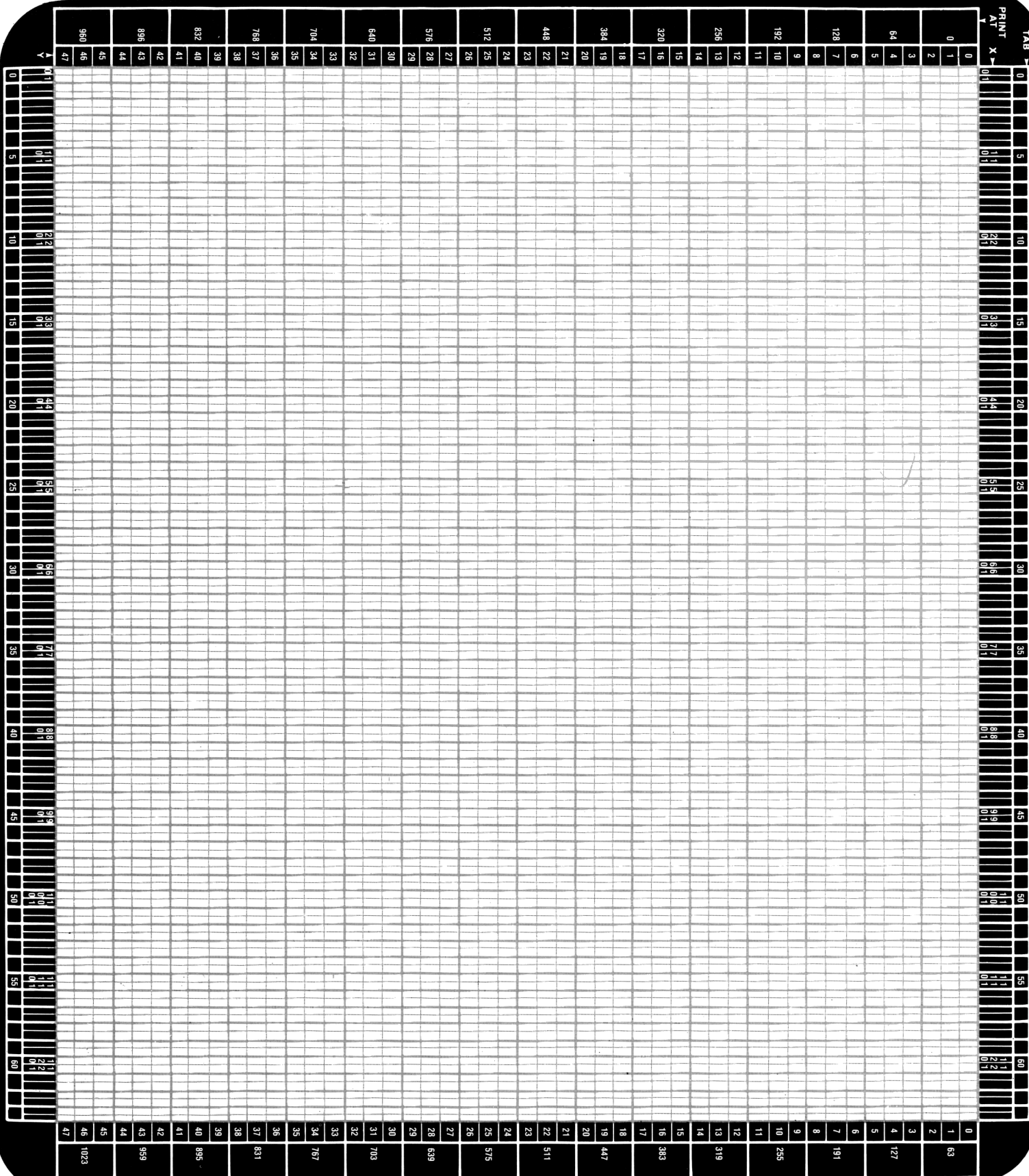
Pretty Good

Only Fair

Not So Hot

FEEDBACK FOR ACTIVITY 7, PROBLEM 2 IS IN THE BACK OF THE STUDENT MANUAL.

TITLE _____ PROGRAMMER _____ PAGE _____ OF _____



INTRODUCTION TO BASIC

LESSON 8

THE READ-DATA STATEMENT

OVERVIEW

In this lesson you will find out another way of getting data into a program. This method is through the use of the READ-DATA statement pair. After learning this method, you will again have the opportunity to enter and execute a program of your design.

OBJECTIVES

By the time you are done studying this lesson, you will be able to:

1. Explain the use of the READ-DATA statement pair.
2. List and explain four rules concerning the use of the READ-DATA statement pair.
3. Explain how the READ-DATA statement pair can be used with the FOR-NEXT statement.

REVIEW

List the main function of each of the following statements:

1. REM _____
2. PRINT _____
3. LET _____
4. GOTO _____
5. IF-THEN _____
6. FOR-NEXT-STEP _____
7. INPUT _____

REVIEW (Continued)

List the main function of each of the following commands or activities:

1. NEW _____
2. RUN _____
3. LIST _____
4. BREAK _____
5. CLEAR _____

There are two ways which we have used to put data into a program. These are:

1. _____
2. _____

THE READ-DATA STATEMENT PAIR

Study this short program and see if you can predict the output:

```
10 DATA 1, 2, 3, 4, 5
20 READ A, B, C, D, E
30 PRINT A
40 PRINT B
50 PRINT C
60 PRINT D
70 PRINT E
```

Output = _____

THE READ-DATA STATEMENT PAIR USED WITH THE FOR-NEXT STATEMENT

Study this program and predict the output:

```
10 DATA 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
20 FOR N=1 TO 10
30 READ A
40 PRINT A
50 NEXT N
```

Output = _____

THE READ-DATA STATEMENT PAIR USED WITH THE FOR-NEXT STATEMENT (Continued)

Look at this program and see if you can find out why it won't run all the way through:

```
10 DATA 100, 200, 300, 400, 500
20 FOR N=1 TO 10
30 READ A
40 PRINT A
50 NEXT N
```

Problem: _____

CONTROLLING THE READ-DATA STATEMENT PAIR

Now look at this program and note how the READ-DATA statement pair is used and again predict the output:

```
10 READ A
20 IF A=999 THEN 60
30 PRINT A
40 GOTO 10
50 DATA 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 999
60 END
```

What is the output? _____

SUMMARY

Some Rules Concerning READ-DATA

1. The information in a _____ statement must be read by a _____ statement.
2. Each piece of data in a DATA statement must be separated by _____.
3. Data lines are always read from _____ to _____.
4. Placement of DATA statements in a program _____.

SUMMARY (Continued)

Principles concerning relationship of number of “reads” and the number of “data elements” to be read:

1. If there are more “reads” than there are “data elements,” _____

2. If there are more “data elements” than “reads,” _____

QUICK QUIZ 8

DIRECTIONS: Using the answer sheet, answer the following questions.

1. Methods of placing data within a program include use of which of the following statements?

A. LET
B. INPUT

C. READ-DATA
D. All of these commands

2. Study the following program and then answer the question:

```
10 DATA 2, 4, 6, 8, 10
20 READ A, B, C, D, E
30 PRINT C
```

What will be the result of line 30?

A. 2
B. 4

C. 6
D. 8

QUICK QUIZ 8 (Continued)

For Questions 3 to 5, use the following program:

```
10 READ A
20 IF A=999 THEN 60
30 PRINT A
40 GOTO 10
50 DATA 1,2,3,4,5,6,7,8,9,10,999
60 END
```

3. Line 20 is an example of a/n

- A. unconditional branch
- B. conditional branch

- C. relational branch
- D. augmented GOTO statement

4. Line 40 is a/n

- A. unconditional branch
- B. relational branch

- C. conditional branch
- D. alternate IF-THEN statement

5. In line 20 the 999 data element acts as a

- A. “stopper”
- B. print statement

- C. dummy data element
- D. data statement

6. The READ statement is always accompanied by the _____ statement.

- A. INPUT
- B. LET

- C. GOTO
- D. DATA

7. In a DATA statement, data elements are always separated by

- A. commas
- B. periods

- C. colons
- D. semi-colons

8. Which is true concerning placement of DATA statements in a program?

- A. They must be the first statements in the program.
- B. They should follow INPUT statements.
- C. They must be the last statements in the program.
- D. They may appear anywhere in the program.

9. If there are more “reads” than there are “data elements,” what will happen?

- A. Data elements will be reread as necessary.
- B. The last data element will be repeatedly read.
- C. The program will abort.
- D. The program will run without difficulty.

10. If there are more “data elements” than “reads,” the program will

- A. read only as much as it needs.
- B. abort.
- C. read all the data elements, regardless.
- D. read only the last data element.

ACTIVITY 8

1. Study this program and explain each step:

```
10 READ A$
20 READ B$
30 DATA JOHN, SMITH
40 PRINT "MY NAME IS "; A$ ; " "; B$
```

Explanation:

10 _____

20 _____

30 _____

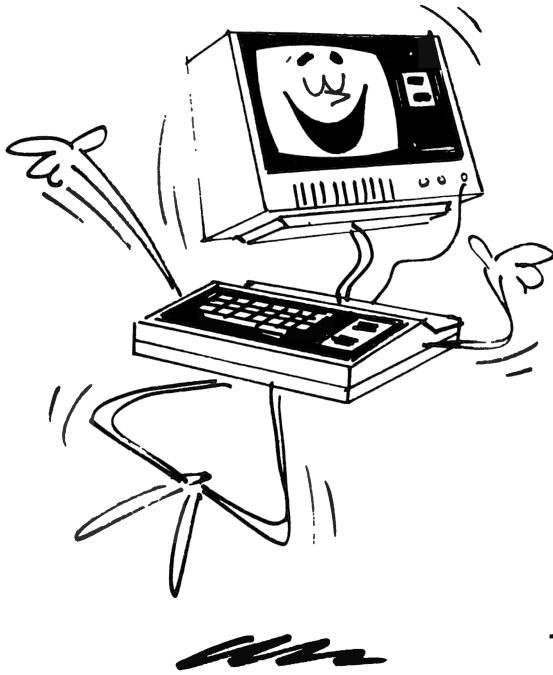
40 _____

Predicted Output: _____

2. Write, enter, and execute a program to READ your name from a DATA statement and then PRINT your name, last name first, and then PRINT it again, first name first. Your output should look like this:

```
NAME (LAST NAME 1ST): SMITH, JOHN
NAME (FIRST NAME 1ST): JOHN SMITH
```


ANSWER SHEET FOR QUICK QUIZ 8



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON THE FIRST TRY

10

9

8

7

BELOW 7

COMMENT

SUPER

GOOD WORK

OK

FAIR

A LITTLE MORE WORK, OK?

FEEDBACK TO ACTIVITY 8, PROBLEM 2 IS IN THE BACK OF THE STUDENT MANUAL.

INTRODUCTION TO BASIC

LESSON 9

SUBROUTINES

OVERVIEW

This lesson presents one way to get a program to do more with fewer steps. It is obvious that anytime a program can be made to do more with fewer steps, savings result. Two statements which are used for this increasing of efficiency are GOSUB-RETURN and ON-GOSUB-RETURN. After being shown how these statements operate, you will have the chance to use them in programming. Again there will be another activity for you to do at the computer .

OBJECTIVES

By the time you have finished studying this lesson on the use of subroutines you will be able to:

1. Explain the general purposes of the GOSUB-RETURN and ON-GOSUB-RETURN statements.
2. Trace the execution of programs which use these two statements.
3. Write programs using these statements to make the programs more efficient.

REVIEW

Two statements which can be used to alter the order of execution are

_____ and _____.

The unconditional branch is indicated by the _____ statement.

The IF-THEN statement is _____.

REVIEW (Continued)

Study this program and indicate the appropriate branches to cause the output to "make sense."

```

10 PRINT "BRANCHING DEMO"
20 GOTO _____
30 PRINT "CONDITIONAL BRANCHING"
40 GOTO _____
50 PRINT "UNCONDITIONAL BRANCHING, AND"
60 GOTO _____
70 PRINT "(1) GOTO IS AN EXAMPLE OF"
80 GOTO _____
90 PRINT "(2) IF-THEN IS AN"
100 PRINT "EXAMPLE OF"
110 GOTO _____
120 END

```

USING THE GOSUB-RETURN STATEMENT PAIR

Study this program and determine the function of the subroutine:

```

10 PRINT "HOW MANY 'AT BATS' ";
20 INPUT A
30 PRINT "HOW MANY HITS ";
40 INPUT B
50 GOSUB 200
60 PRINT "BATTING AVERAGE IS";M
70 PRINT "HOW MANY FIELDING ATTEMPTS ";
80 INPUT A
90 PRINT "HOW MANY WITHOUT ERROR ";
100 INPUT B
110 GOSUB 200
120 PRINT "FIELD AVERAGE IS";M
130 END
200 M=B/A
210 RETURN

```

Function of subroutine: _____

Using arrows trace the execution of the program.

State the rule that explains which statement the program goes to in executing the RETURN portion of the GOSUB-RETURN statement pair.

USING THE ON-GOSUB-RETURN STATEMENT PAIR

Study this program and then answer the question following the program listing:

```

10 INPUT "TYPE 1 FOR BATTING AVERAGE, 2 FOR FIELDING AVERAGE";N
20 IF N>2 THEN 10
30 ON N GOSUB 70, 100
40 INPUT "ENTER 0 FOR ANOTHER TRY";A
50 IF A=0 THEN 10
60 END
70 INPUT "NO. OF HITS, NO. OF AT BATS";A,B
80 PRINT "BATTING AVERAGE =" ;A/B
90 RETURN
100 INPUT "NO. OF ERRORS, NO. OF ATTEMPTS";C,D
110 PRINT "FIELDING AVERAGE =" ;(D-C)/D
120 RETURN

```

Why two subroutines? _____

What happens if the person running the program responds with a 0 in line 40? _____

Why does program stop if the response to line 40 is anything except 0? _____

SUMMARY

The use of subroutines provides savings in the following ways:

The statements used to call subroutines are:

The END statement is used to _____

QUICK QUIZ 9

DIRECTIONS: Respond to these questions on the answer sheet.

1. Which of these statements must be used with the GOSUB statement?
A. ON
B. PRINT
C. RETURN
D. NEXT

2. When the RETURN statement is executed, which is the statement to be executed?
A. The statement before the GOSUB.
B. The last statement of the program.
C. The first statement after the RETURN.
D. The statement following the GOSUB.

3. If N has a value of 2 and the following line is executed, what is the number of the next line to be executed?
30 ON N GOSUB 50, 60, 70, 80
A. 50
B. 60
C. 70
D. 80

4. Why is it necessary to have an END statement between the “body” of the program and the subroutine?
A. To keep subroutines available for regular execution.
B. To cause computer to make extra “passes” through program.
C. To cause computer not to store extra data.
D. To keep from executing subroutines an extra time.

5. Subroutines save in amount of program to be typed into the computer and in
A. the amount to be stored in memory.
B. the number of times a user responds to program.
C. the amount of data a user has to enter into the computer as a result of the program.
D. All of the above responses.

For questions 6-10 study the following program listing and then respond to the questions:

```

10 REM SUBROUTINE DEMO PROGRAM
20 PRINT "ENTER TWO SINGLE-DIGIT NUMBERS"
30 INPUT A,B
40 INPUT "1=ADD, 2=SUBTRACT, 3=MULTIPLY, 4=DIVIDE";N
50 IF N>4 THEN 40
60 ON N GOSUB 110,130,150,170
70 PRINT "ENTER 0 FOR MORE";
80 INPUT A
90 IF A=0 THEN 20
100 END
110 PRINT A; " + "; B; " = "; A+B
120 RETURN
130 PRINT A; " - "; B; " = "; A-B
140 RETURN
150 PRINT A; " * "; B; " = "; A*B
160 RETURN
170 PRINT A; " / "; B; " = "; A/B
180 RETURN

```

6. If the response to line 40 is 2, the next line to be executed, after line 60, is

A. 110	C. 130
B. 120	D. 140
7. After the subroutine in lines 130 and 140 is executed, the next statement to be executed is in line

A. 50	C. 70
B. 60	D. 80
8. If the response to line 40 is 5, the next statement to be executed is in line

A. 50	C. 70
B. 60	D. 80
9. If the response to line 80 is 0, the next two lines to be executed are

A. 90, 20	C. 90, 100
B. 20, 50	D. 10, 20
10. If the response to line 80 is NOT 0, what will the program do?

A. Stop and report error.	C. Continue on to line 110.
B. Report error and continue.	D. Fall through line 90 and END on line 100.

ACTIVITY 9

1. Complete this program so it will "make sense."

```

10 PRINT "ENTER ANY 2 INTEGERS"
20 INPUT _____
30 PRINT "1 FOR SUM, 2 FOR PRODUCT"
40 INPUT N
50 IF N>2 THEN 30
60 ON N GOSUB _____,_____
70 END
80 PRINT "THE SUM OF ";A;" AND ";B;" IS ";A+B
90 _____
100 PRINT "THE PRODUCT OF ";A;" AND ";B;" IS ";A*B
110 _____

```

Enter the "modified" version and check it out.

2. Write, enter, execute, and debug a program using subroutines to produce output which looks like this:

```

LENGTH AND WIDTH OF RECTANGLE? 3,4
1 FOR AREA, 2 FOR PERIMETER? 1
AREA = 12 SQUARE UNITS
TYPE 0 FOR MORE? 0
LENGTH AND WIDTH OF RECTANGLE? 5,6
1 FOR AREA, 2 FOR PERIMETER? 2
PERIMETER = 22 LINEAR UNITS
TYPE 0 FOR MORE? 1
READY

```


ANSWER SHEET FOR QUICK QUIZ 9



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON FIRST TRY

10

9

8

7

Below 7

COMMENT

SUPER WORK

GOOD JOB

O.K.

NOT SO HOT

A LITTLE MORE EFFORT PLEASE

FEEDBACK TO ACTIVITY 9, PROBLEM 2 IS IN THE BACK OF THE STUDENT MANUAL.

INTRODUCTION TO BASIC

LESSON 10

NUMERIC ARRAYS

OVERVIEW

In this lesson you will be shown a way of assigning many more values to one variable name, thus increasing your ability to work with greater amounts of information at one time. To learn just how to extend the use of variables using BASIC you will learn about numeric arrays and their dimensions, and matrices (plural of matrix). After learning these concepts you will have the opportunity to program the microcomputer using these new techniques.

OBJECTIVES

By the time you have completed your study of this lesson, you will be able to:

1. Define the following terms related to numeric arrays in BASIC: numeric array, dimension, matrix.
2. Explain the main purpose for using numeric arrays.
3. Create one- and two-dimensional numeric arrays.
4. Develop, enter, and run programs using numeric arrays.

REVIEW

The statements which allow repeated calling of a specified set of instructions from anywhere within a program are _____ and _____.

Two savings resulting from the use of these statements are:

1. _____
2. _____

REVIEW (Continued)

This is the general model for a program using subroutines:

```

10 (1ST PART OF PROGRAM)
20 GOSUB 100
30 (2ND PART OF PROGRAM)
40 GOSUB 100
50 (3RD PART OF PROGRAM)
60 GOSUB 100
70 END
100 (SUBROUTINE)
110 RETURN

```

Trace the execution: _____

Why is the END statement used? _____

INTRODUCTION TO NUMERIC ARRAYS

Here is one example of a numeric array:

```

101  102  103  104  105  106  107  108

```

Here is another example of a numeric array:

```

3.5  4.0  3.5  3.0  2.0  2.5  2.0  2.5

```

Definition of a numeric array: _____

Here is a program in BASIC which will assign a series of numbers to one variable.
Complete the missing lines.

```

10 A(1)=100
20 A(2)=200
30 A(3)=300
40 _____
50 _____
60 _____
70 _____
80 _____

```

DISPLAYING A NUMERIC ARRAY

If we wished to display the array just developed, we could add these statements to the program.

```

10 A(1)=100
20 A(2)=200
30 A(3)=300
40 A(4)=400
50 A(5)=500
60 A(6)=600
70 A(7)=700
80 A(8)=800
90 FOR I=1 TO 8
100 PRINT A(I)
110 NEXT I

```

What will be the output of this program? _____

ALTERNATE METHOD FOR ASSIGNING VALUES IN A NUMERIC ARRAY

Using the FOR-NEXT and READ-DATA statements, write a program to assign the following 10 values to the variable A.

1062 1173 1258 1341 1397 1415 1427 1429 1500 1612

10 _____

20 _____

30 _____

40 _____

TERMINOLOGY OF NUMERIC ARRAYS

NUMERIC ARRAY _____

DATA ELEMENT _____

A (3) _____

DIMENSIONS OF NUMERIC ARRAYS

Look at this numeric array:

107.2 345.6 212.0 32.1 98.72

It is called a _____-dimensional array. Why? _____

Look at this numeric array:

STUDENT #	GRADE
10016	2.0
31427	3.5
16167	3.0
71668	4.0
51625	3.5

This is a _____-dimensional array. Why? _____

This is called a MATRIX.

CREATING A TWO-DIMENSIONAL ARRAY

Study this program:

```
10 FOR I=1 TO 5
20 READ A(I)
30 NEXT I
200 DATA 1172, 6147, 3158, 3494, 4539
```

What would be the result of executing these lines?

Study this same program with these additional lines .

```
10 FOR I=1 TO 5
20 READ A(I)
30 NEXT I
40 FOR J=6 TO 10
50 READ A(J)
60 NEXT J
200 DATA 1172, 6147, 3158, 3494, 4539
210 DATA 7.0, 6.9, 7.4, 6.8, 6.8
```

What will the variable A look like after these lines are run? _____

CREATING A TWO-DIMENSIONAL ARRAY (Continued)

Now look at this output:

STUDENT #	TIME
1172	7
6147	6.9
3158	7.4
3493	6.8
4539	6.7

How many dimensions? _____

What is in each dimension? _____

PRINTING A TWO-DIMENSIONAL ARRAY

Study lines 70-100 of this same program:

```

10 FOR I=1 TO 5
20 READ A(I)
30 NEXT I
40 FOR J=6 TO 10
50 READ A(J)
60 NEXT J
70 PRINT "STUDENT #", "TIME"
80 FOR I=1 TO 5
90 PRINT A(I), A(I+5)
100 NEXT I
200 DATA 1172, 6147, 3158, 494, 4539
210 DATA 7.0, 6.9, 7.4, 6.8, 6.7

```

How is a two-dimensional matrix output by the program?

SUMMARY

Identify the definitions of the following terms:

Numeric Array _____

Dimension _____

Matrix _____

QUICK QUIZ 10

DIRECTIONS: Using the answer sheet, respond to the following questions.

1. In BASIC a set of numbers assigned to one variable is called a

- A. linear variable**
- B. numeric array**

- C. list**
- D. matrix**

2. A (4) is read

- A. "A-SUB-4"**
- B. "A-PAREN-4-PAREN"**

- C. "A-ELEMENT-4"**
- D. "A-POSITION-4"**

3. If A has these values assigned: 15, 17, 13, 21, 8, 16, then A (4) equals

- A. 15**
- B. 17**

- C. 13**
- D. 21**

4. An individual number in a numeric array is termed a(n)

- A. dimension**
- B. matrix**

- C. element**
- D. subelement**

For Questions 5-10 refer to the following program which creates a two-dimensional array:

```

10 REM STUDENTS AND THEIR HEIGHTS
20 FOR I=1 TO 5
30 READ A(I)
40 NEXT I
50 FOR J=6 TO 10
60 READ A(J)
70 NEXT J
80 PRINT "STUDENT #", "HEIGHT"
90 FOR L=1 TO 5
100 PRINT A(L), A(L+5)
110 NEXT L
120 DATA 1, 2, 3, 4, 5
130 DATA 55, 61, 68, 54, 60

```

5. How many rows will be in this matrix of student numbers, and heights?
 - A. 3
 - B. 4
 - C. 5
 - D. 6
6. How many columns?
 - A. 1
 - B. 3
 - C. 2
 - D. 4
7. What will be the heading of column 2?
 - A. STUDENT #
 - B. HEIGHT
 - C. WEIGHT
 - D. None of these
8. What is the height of Student #3?
 - A. 55
 - B. 60
 - C. 68
 - D. 59
9. What is the height of Student #5?
 - A. 61
 - B. 60
 - C. 54
 - D. 68
10. What is the output produced in lines 80 through 110 called?
 - A. A one-dimensional matrix
 - B. A two-dimensional matrix
 - C. A three-dimensional matrix
 - D. a 10 × 3 string

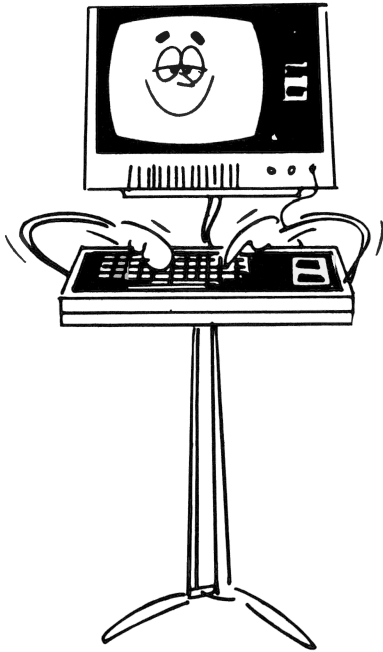
ACTIVITY 10

1. Write a program to assign to elements 1 through 10 of variable A the values 16 through 25 and have the computer display the results.

*2. Write a program to produce a matrix which looks like this:

STUDENT NUMBER	STANDING HIGH JUMP (CM)
-----	-----
10162	115
13145	123
10175	101
12115	130
11011	108

ANSWER SHEET FOR QUICK QUIZ 10



	A	B	C	D
1.	()	()	()	()
2.	()	()	()	()
3.	()	()	()	()
4.	()	()	()	()
5.	()	()	()	()
6.	()	()	()	()
7.	()	()	()	()
8.	()	()	()	()
9.	()	()	()	()
10.	()	()	()	()

HOW DID YOU DO ON THE QUIZ?

NUMBER CORRECT ON FIRST TRY

9 or 10

7 or 8

5 or 6

Below 5

COMMENT

EXCELLENT!

PRETTY GOOD

ONLY FAIR

THAT'S WAY BELOW PAR!

FEEDBACK FOR ACTIVITY 10 IS IN THE BACK OF THE STUDENT MANUAL.

ANSWERS FOR QUICK QUIZZES

	Quiz 1	Quiz 2	Quiz 3	Quiz 4	Quiz 5
1.	C	C	B	A	C
2.	B	B	C	D	A
3.	B	A	A	C	D
4.	C	D	A	B	C
5.	D	D	C	A	A
6.	D	A	D	B	B
7.	C	C	C	A	D
8.	A	A	A	D	C
9.	D	A	C	B	A
10.	B	A	C	C	C
	Quiz 6	Quiz 7	Quiz 8	Quiz 9	Quiz 10
1.	B	A	D	C	B
2.	A	B	C	D	A
3.	D	C	B	B	D
4.	C	C	A	D	C
5.	A	A	A	A	C
6.	C	D	D	C	C
7.	B	B	A	C	B
8.	A	C	D	A	C
9.	A	A	C	A	B
10.	A	A	A	D	B



FEEDBACK FOR ACTIVITIES

Activity 2

Problem 2

```
10 REM GPH COMPUTATION
20 LET G=21.25
30 LET H=8.5
40 PRINT "GPH=";G/H
```

Problem 3

```
10 REM MPG AND MPH COMPUTATION
20 LET D=1092
30 LET T=21
40 LET G=56.1
50 PRINT "MPG =" ;D/G
60 PRINT "MPH =" ;D/T
```

Activity 3

Problem 2

```
10 REM MPL COMPUTATION
20 LET D=402
30 LET G=20.1
40 LET L=G * 3.785
50 PRINT "MPL =" ;D/L
```

Problem 3

```
10 REM KPL COMPUTATION
20 LET K=330 * 1.609
30 LET L=14.8 * 3.785
40 PRINT "KPL =" ;K/L
```

Activity 4

Problem 1

```
10 REM SUM OF ODD INTEGERS 1 - 21
20 K=1
30 S=0
40 PRINT K
50 S = S + K
60 K = K + 2
70 IF K < 23 THEN 40
80 PRINT "-----"
90 PRINT S
```

Activity 5

Problem 2

```
10 REM COUNTING BY 5'S
20 K = 0
30 K = K + 5
40 PRINT K
50 IF K < 25 THEN 30
60 PRINT "ALL DONE"
```

Activity 6

Problem 2

```
10 FOR N=1 TO 10
20 PRINT N, N * N
30 NEXT N
```

Activity 7

Problem 2

```
10 CLS
20 FOR I = 0 TO 47
30 SET(0,I)
40 NEXT
50 FOR K = 47 TO 0 STEP -1
60 SET(127,K)
70 NEXT K
80 FOR M=1 TO 1500
90 NEXT M
```

Activity 8

Problem 2

```
10 READ A$
20 READ B$
30 DATA JOHN,SMITH
40 PRINT "NAME (LAST NAME 1ST): "; B$; ", "; A$
50 PRINT "NAME (FIRST NAME 1ST): "; A$; " "; B$
```

Activity 9

Problem 2

```
10 REM AREA/PERIMETER PROGRAM
20 INPUT "LENGTH AND WIDTH OF RECTANGLE"; L,W
30 INPUT "1 FOR AREA, 2 FOR PERIMETER"; N
40 IF N > 2 THEN 30
50 ON N GOSUB 90, 110
60 INPUT "TYPE 0 FOR MORE"; A
70 IF A=0 THEN 20
80 END
90 PRINT "AREA ="; L*W; " SQUARE UNITS"
100 RETURN
110 PRINT "PERIMETER ="; 2 * (L+W); " LINEAR UNITS"
120 RETURN
```

Activity 10

Problem 1

```
10 FOR I = 1 TO 10
20 A(I) = I + 15
30 NEXT I
40 PRINT "RESULTS"
50 FOR J= 1 TO 10
60 PRINT A(J);
70 NEXT J
```

Problem 2

```
10 REM STUDENTS AND THEIR HIGH JUMPS
20 PRINT " STUDENT", " STANDING"
30 PRINT " NUMBER ", " HIGH JUMP(CM)"
40 PRINT " -----", " -----"
50 FOR L = 1 TO 5
60 READ A,B
70 PRINT A,B
80 NEXT L
90 DATA 10162,115,13145,123
100 DATA 10175,101,12115,130
110 DATA 11011,108
```

