**Subprograms**

**In General:** the program compound of main part called the **main program** and secondary part called **subprograms**.

**Subprogram :** is an independent program put inside the main program to performed a certain action many times, this subprogram written one time and can recall many times, this reduce the length of the program.

Subprograms can be divided into:

1. Subroutines.
2. Functions.

1- Subroutines: it is an independent program put after the end statement of the main program and consists of a certain numbers of statements. The subroutine terminated with return statement which referred to return to the main program .

The general form of the subroutine is:

No. of statement in main program **GOSUB** no. of statement of starting subroutine

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.

End statement of main program

No. of statement of subroutine …..

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No. of statement of ending subroutine **RETURN**

**Such as:**

10 READ A,B,C

20 DATA 5,10,15

Main program

30 **GOSUB** **100**

40 PRINT X

50 END

**100** REM FIND THE SUMATION

Subroutine

110 X = A+B+C

**120** **RETURN**

**Ex1 :** write a program to read the value of K, N and then find the result of the equation below

$$D= \frac{N !}{\left(N-K\right)!×K!}$$

10 INPUT K,N

20 F1= 1

30 for I = 1 to N

40 F1=F1 × I

50 NEXT I

60 F2 = 1

70 FOR J = 1 TO K

80 F2 = F2 × J

90 NEXT J

100 F3 = 1

110 FOR M = 1 TO (N-K)

120 F3 = F3 × M

130 NEXT M

140 D = F1 / (F3 × F2)

150 PRINT D

160 END

**Ex2 :** write a program to read the value of K, N and then find the result of the equation below **using subroutine.**

$$D= \frac{N !}{\left(N-K\right)!×K!}$$

10 INPUT K,N

20 M = N

**30 GOSUB 150**

40 A = X

50 M = N – K

**60 GOSUB 150**

70 B = X

80 M = K

**90 GOSUB 150**

100 C = X

110 D = A/(B×C)

120 PRINR D

130 END

**150 REM SUBROUTINE OF FICTORIAL**

160 X = 1

170 FOR I = 1 TO M

180 X = X × I

190 NEXT I

**200 RETURN**

**Ex 3:** write a program to read the matrix A(N,M) and use a subroutine to find the transpose of the matrix (AT) and then print the result matrix.

10 REM MAIN PROGRAM

20 INPUT N,M

30 FOR I = 1 TO N

40 FOR J = 1 TO M

50 READ A(I,J)

60 NEXT J

70 NEXT I

**80 GOSUB 200**

90 FOR I = 1 TO N

100 FOR J = 1 TO M

110 PRINT B(I,J)

120 NEXT J

130 PRINT

140 NEXT I

150 DATA

160 END

**200 REM SUBROUTINE**

210 FOR I = 1 TO N

220 FOR J = 1 TO M

230 B(I,J) = A(J,I)

240 NEXT J

250 NEXT I

**260 RETURN**

**Ex 4:** Write a program to descending arrange three numbers (X1,X2,X3) and then print the result . Using a subroutine in solve.

10 REM MAIN PROGRAM

20 INPUT X1,X2,X3

30 IF X1 > X2 THEN 50

**40 GOSUB 90**

50 IF X2 > X3 THEN 70

**60 GOSUB 140**

**65 GOSUB 30**

70 PRINT “A=”;X1,”B=”;X2,”C=”;X3

80 END

**90 REM SUBROUTINE**

100 A=X1

110 X1 = X2

120 X2 = A

**130 RETURN**

**140 REM SUBROUTINE**

150 B = X3

160 X3 = X2

170 X2 = B

**180 RETURN**

**Ex 5:** Write a program to find the summation of the sequence below and then print the result. Using a subroutine in solve.

1/1! + 1/2! + 1/3! + 1/4! + ………….1/10!

10 REM MAIN PROGRAM

20 SUM = 0

30 FOR N = 1 TO 10

**40 GOSUB 100**

50 PRINT “X=”; X

60 SUM = SUM +X

70 NEXT N

80 PRINT “N=”; N; “SUM=”; SUM

90 END

**100 REM SUBROUTINE**

110 X = 1

120 FOR J = 1 TO N

130 X = X × J

140 NEXT J

150 X = 1 / X

**160 RETURN**

2- Functions : in general there are three types of functions usually used in basic language :

1. Library functions.
2. Single line functions.
3. Multi-lines functions.
4. Library functions : this type of functions defined and saved in the memory of computer, when need to use it , only mention the name of the functions.

Such as (SIN (X) , COS (X) , SQR (X) , ABS (X) , **INT (X)** , **RND (X)** , …)

a-1- **The INT (X) Function :** this function use to select integer numbers in a certain range, where the INT (X) means the max number **less or equal** to X.

such as :

INT (9.875) = 9 (the max. integer number less or equal to 9.875).

INT (9.25) = 9 (the max. integer number less or equal to 9.25).

INT (-7.66) = -8 (the max. integer number less or equal to -7.66).

INT (-7.22) = -8 (the max. integer number less or equal to -7.22).

The usage of INT (X) function :

1. Approximate the real number to the nearest integer number, by adding (0.5) to the real number. **INT (X+0.5)**

For X = 10.6

When use **INT (X)** = INT (10.6) = 10 (approximate to lower value)

When use **INT (X+0.5)** = INT (10.6+0.5) = 11 (approximate to upper value).

1. Approximate the fracture part of any real number.

**INT (10×X+0.5)/10** used to approximate the fracture part to one number after comma. (if x=**2.215** the result of function = **2.2**)

**INT (100×X+0.5)/100** used to approximate the fracture part to two numbers after comma. (if x=**2.215** the result of function = **2.22**)

**INT (1000×X+0.5)/1000** used to approximate the fracture part to three numbers after comma. (if x=**2.215** the result of function = **2.226**)

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1. Finding the fracture part for any real number.

X – INT (X)

(for x = 2.215 the result of the function is 0.215).

1. Finding the remain of division of any two integer numbers.

X – Y \* INT (X/Y)

(for x = 34 and y = 9 the result of the function is 7)

This function can use to determine whether the number is odd or even.

a-2- **The RND (X) Function (Random Number Functions):** this function use in the statistics to generate a number between two numbers and this number represent a uniformly distribution.

**Y = RND (X)**

this is mean the variable Y will take a random value between 0 and 1.(0 ≤ Y ≤ 1).

Ex : run the following program :

10 X = 0

Run :

20 Y = RND (X)

30 ? Y

40 END

To generate N numbers from the random number between 0 and 1 can use the following program :

10 INPUT N

Run :

20 X = 0

30 FOR I = 1 TO N

40 Y = RND (X)

50 ? Y

60 X = Y

70 NEXT I

80 END

**Y = (M – N) \* RND (X) + N**

This is used to generate a random value range between two different number (**M** and **N**) where N , M are integer numbers and the value of M greater than N.

For M = 5 and N = 2 the result of running the following program :

10 INPUT M , N

Run :

20 X = 0

30 **Y = (M – N) \* RND (X) + N**

40 ? “ Y = “ ; Y

1. END
2. Single Line Functions.

Functions write in one line after difinision at the start of the program, and can reused in the program by mension it name.

The general form is:

No. of statement

DEF FNA (exchangable variable) =

mathmetical expression or string expression

Where :

A : the name of the function.

Ex 1: write a program to approximate the values of X to the upper nearest number by using the single line function. (X = -2.9 , 99.427 , -3.35 , 22.426 ).

10 REM DEFINED FUNCTION

20 **DEF FNT (X) = INT (X+0.5)**

Run :

30 REM MAIN PROGRAM

40 FOR I = 1 TO 4

50 READ A

60 **B = FNT (A)**

70 ? B

80 NEXT I

90 DATA -2.9 , 99.427 , -3.35 , 22.426

100 END

**Ex 2:** write a program to approximate the values of X for two numbers after comma by using the single line function. (X = 2.44 , -56.3242 , 29.569 , -6.6589 ).

10 REM DEFINED FUNCTION

20 **DEF FNT (X) = INT (100 × X+0.5)/100**

30 REM MAIN PROGRAM

40 FOR I = 1 TO 4

Run :

50 READ C

60 **D = FNT (C)**

70 ? C , D

80 NEXT I

90 DATA 2.44 , -56.3242 , 29.569 , -6.6589

100 END

**Ex 3:** by using the random function write a program to generate (N) of interger number compound of two and three numbers.

10 REM GENERATION OF TWO DIGITS NUMBER

20 INPUT N

30 FOR I = 1 TO N

40 M(I) = INT (100× RND (1))

50 PRINT “M(“I”)=”;M(I)

60 NEXT

70 REM GENERATION OF THREE DIGITS NUMBER

80 FOR I = 1 TO N

90 K(I) = INT (1000×RND(1))

100 PRINT “K(‘I”)=”;K(I)

110 NEXT I

120 END

**Ex 4:** by using the INT function write a program to approximate any real number to:

1. one numbers after comma.
2. Two numbers after comma.

10 REM ROUNDING A NUMBER TO TENTH AND HUNDERTH

20 INPUT X

30 M = INT (10 × X + 0.5)/10

40 ? “M=” ; M

50 N = INT (100 × X + 0.5)/100

60 ? “N=”; N

1. END
2. **Multi-lines functions.**

This type of function differe from one line function in the definision of function where the diffinision of multi-line required more than one line to define.