Name: _____ Student ID: _____ Date: _____
Name: _____ Student ID: _____

Worksheet #8
Function

Objectives

- To understand how functions work in ARM processor
- To create functions from branch instructions and label in ARM

1. Create a new project, then type and add the following code to the project.

```
        AREA  PROG8_1,  CODE,  READONLY
        ENTRY
start
        MOV   a1, #X
        BL  func
        B     loop

func    MOV  v1, #0
        MOV  v2, #0
floop   CMP    v1, a1
        BGT    done
        ADD    v2, v2, v1
        ADD    v1, v1,  #1
        B    flop
done    MOV   a1, v2
        BX    LR

loop    B   loop
        END
```

Program 8.1

2. Replace X in the program above with the value shown in Table 8.1.
3. Build and Run the program. Then observe and record the results in Table 8.1.

The values of	**The results from program 8.1**	
X	**R0 (hex format)**	**R0 (decimal format)**
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Table 8.1

4. What does the program 8.1 do with the value of X ?

_____

_____

5. Create a new project, then type and add the following code to the project.

```
        AREA  PROG8_2,  CODE,  READONLY
        ENTRY
start
        MOV   a1, #X
        BL      func
        MOV   a2,   a1
        MOV   a1, #Y
        BL      func
        ADD   a3, a2, a1
        B     loop

func    ADD  v1, a1, #1
        MUL  a1, v1, v1
        BX   LR

loop    B   loop
        END
```

Program 8.2

6. Replace X and Y in the program above with the value shown in Table 8.2.
7. Build and Run the program. Then observe and record the results in Table 8.2.

The values of		**The results from program 8.2**	
X	**Y**	**R2 (hex format)**	**R2 (decimal format)**
1	2		
2	2		
3	3		
4	3		
5	4		
1	4		
2	5		
3	5		
4	6		
5	6		

Table 8.2

8. What does the program 8.2? Write the mathematics expression of R2 that depends on the value of X and Y.

R2 = _____

9. Complete the program below to calculate the mathematics expression

$$R3 = 2^4 + 3^3 - 2^3 + 10$$

```
        AREA  PROG8_3,  CODE,  READONLY
        ENTRY
start

POWER3
        MUL  v1, a2, a2
        MUL  a2, v1, v1
        BX   LR

POWER4
        MUL  v1, a2, a2
        MUL  v2, a2, a2
        MUL  a2, v1, v1
        BX   LR

loop    B   loop
        END
```

Program 8.3

10. What is the value in R3 after the program is executed
    - Hexadecimal Format : _____
    - Decimal Format : _____

11. Complete function X_POWER_Y in the program below to calculate the mathematics expression

$$a1 = a1^{a2}$$

Hint: You can use loop instruction or simple use left shift operator.

```
        AREA PROG8_4, CODE, READONLY
        ENTRY
start
        MOV a1, #X
        MOV a2, #Y
        BL  X_POWER_Y
        ADD  a1, a1, #10
        B loop

X_POWER_Y









loop    B  loop
        END
```

Program 8.4

12. Replace X and Y in the program above with the value shown in Table 8.3.
13. Build and Run the program. Then observe and record the results in Table 8.3.

The values of		The results from program 8.4	
X	**Y**	**R0 (hex format)**	**R0 (decimal format)**
2	2		
2	3		
2	4		
3	2		
3	3		
3	4		

Table 8.3

14. Complete function SWAP_XY in the program below to swap between the value stored in a1 and a2

```
        AREA PROG8_5, CODE, READONLY
        ENTRY
start
        MOV a1, #0x100
        MOV a2, #0x200
        BL  SWAP_XY
        B loop

SWAP_XY









loop    B  loop
        END
```

Program 8.5

15. From program 8.5, Write the value stored in R0 and R1 **before** calling the SWAP_XY function.

    R0 = _____

    R1 = _____

16. From program 8.5, Write the value stored in R0 and R1 **after** calling the SWAP_XY function.

    R0 = _____

    R1 = _____

17. Write a program to calculate the electric power by using this formula

$$P = I * R^2$$

Let

- a1 stored the value of I (In the program, write #I, instead of fixed value)
- a2 stored the value of R (In the program, write #R, instead of fixed value)
- a3 stored the value of P

```
        AREA  PROG8_6,  CODE,  READONLY
        ENTRY
start




        BL   POWER_CALCULATE
        B    loop

POWER_CALCULATE




loop    B   loop
        END
```

Program 8.6

18. Replace I and R in the program above with the value shown in Table 8.4.
19. Build and Run the program. Then observe and record the results in Table 8.4.

The values of		**The results from program 8.6**	
I	**R**	**a3 (hex format)**	**a3 (decimal format)**
2	2		
2	3		
2	4		
3	2		
3	3		
3	4		

Table 8.4

20. Write a program to calculate the expression below

$$R5 = (5! + (3-2)!) + 3!$$

The main program must call the function FACTORIAL to compute the factorial value.

```
        AREA  PROG8_7,  CODE,  READONLY
        ENTRY
start

FACTORIAL

loop    B   loop
        END
```

Program 8.7

21. What is the result that we obtained in R3 after execute the program 8.7
    - Hexadecimal Format: _____
    - Decimal Format: _____