A-LEVEL COMPUTER SCIENCE • EXERCISE SHEET

11.3 Structured Programming

Name: _____ Class: _____ Date: _____ **Total: 17 marks**

Objective

Build the skills to answer exam questions on **structured programming** 结构化编程— procedures, functions and parameters.

You must be able to:

- define and **call** a **procedure** and a **function**
- use **parameters**, including **by value** and **by reference**
- use the terms argument, parameter, return value, **local/global**

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

■ Procedure vs function

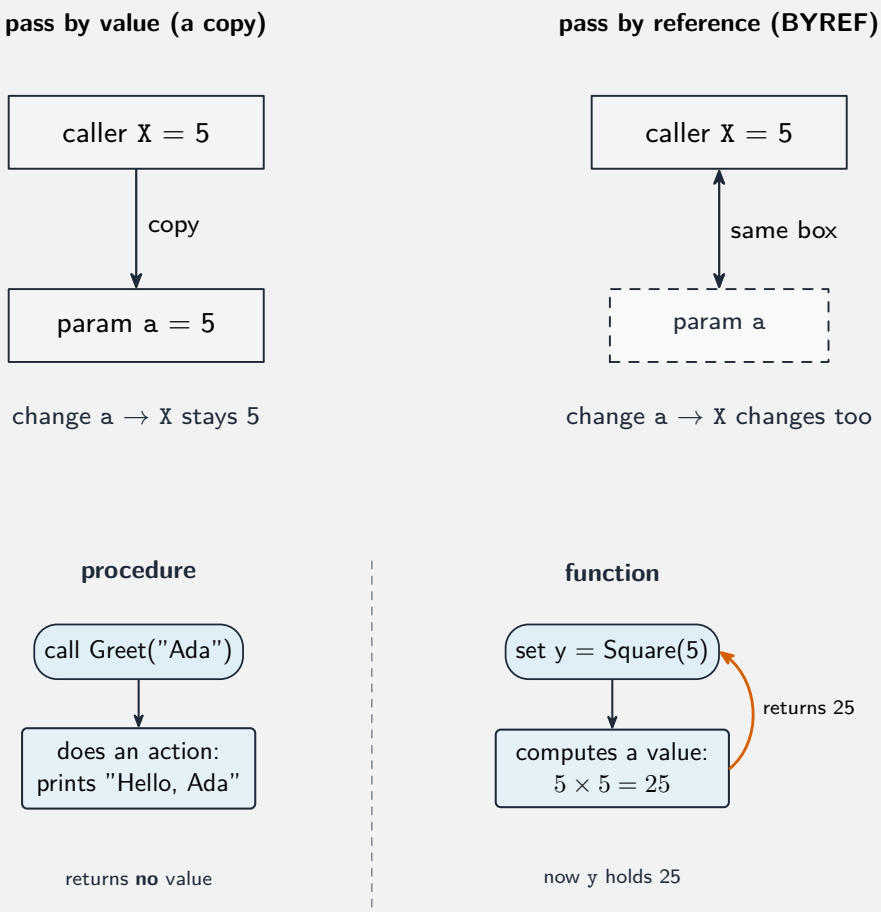
A **procedure** does an action and returns **nothing**; a **function** returns a **value** used in an expression.

```
PROCEDURE Greet(Name : STRING)
    OUTPUT "Hello, ", Name
ENDPROCEDURE
CALL Greet("Ada")

FUNCTION Square(x : INTEGER) RETURNS INTEGER
    RETURN x * x
ENDFUNCTION
Result ← Square(5) + 1      // Result = 26
```

■ Parameters: by value or by reference

A **parameter** is the variable that **receives** input; the value the caller supplies is the **argument**.



Procedures and functions structure a program

`Swap` must use **`BYREF`** so the new values stay in the caller:

```
PROCEDURE Swap(BYREF a : INTEGER, BYREF b : INTEGER)
    DECLARE temp : INTEGER
    temp ← a
    a ← b
    b ← temp
ENDPROCEDURE
```

■ Local, global, and when to use a subroutine

A **local** variable lives only inside its subroutine; a **global** is visible everywhere (prefer locals). Use a subroutine when logic **repeats**, has a **clear purpose**, or to **test** a part on its own.

2 Practice

Now apply the methods above.

2.1 State **one** difference between a **procedure** and a **function**. [1]

2.2 Define a procedure `Greet(Name)` that outputs `"Hello, "` followed by the name. [2]

2.3 Define a function `Cube(x)` that returns `x` cubed. [2]

2.4 State the difference between an **argument** and a **parameter**. [2]

3 Exam-style questions

3.1 Write a **function** `MaxOf(a, b)` that returns the larger of two integers. [3]

3.2 Explain **pass by value** and **pass by reference**, and state which one a `Swap` procedure must use, and why. [4]

3.3 State **two** benefits of using subroutines in a large program. [2]

3.4 State what is meant by a **local variable**. [1]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **11.3 Structured Programming** past-paper sheet in the Library, or try these in **Practice mode**:

- 9618/21 N25 —Q4 (procedures and functions)
- 9618/23 J25 —Q3 (parameters)
- 9618/23 J25 —Q5 (functions and return values)
- 9618/22 N25 —Q4 (structured programming)

Solutions

2.1 A **function returns a value** (used in an expression); a **procedure does not** return a value (it performs an action).

2.2

```
PROCEDURE Greet(Name : STRING)
    OUTPUT "Hello, ", Name
ENDPROCEDURE
```

2.3

```
FUNCTION Cube(x : INTEGER) RETURNS INTEGER
    RETURN x * x * x
ENDFUNCTION
```

2.4 An **argument** is the value the caller passes in; a **parameter** is the variable inside the subroutine that **receives** it.

3.1

```
FUNCTION MaxOf(a : INTEGER, b : INTEGER) RETURNS INTEGER
    IF a > b THEN
        RETURN a
    ELSE
        RETURN b
    ENDIF
ENDFUNCTION
```

3.2 By value —the routine gets a **copy**, so changes inside it do **not** affect the caller. **By reference** —the routine shares the caller's actual variable, so changes **do** affect it. `Swap` must use **pass by reference (`BYREF`)** so the swapped values remain in the caller's variables after the call.

3.3 Any two: avoids repeating code; easier to read/maintain; can be tested on its own; supports decomposition/teamwork.

3.4 A variable declared **inside** a subroutine that exists **only while that subroutine runs** (and is not visible outside it).