

11.1.2 Built-in functions and library routines

Name: _____ Class: _____ Date: _____

Total: 48 marks

KEY WORDS built-in functions 内置函数 • library routines 库例程 • parameters 参数
• concatenates 拼接 • program library 程序库

Objective

Learn to use the **built-in functions** 内置函数 and **library routines** 库例程 of pseudocode: the string functions, the conversion functions and the numeric functions that the Paper 2 **insert** 附页 gives you. This is the last sheet of 11.1. You need the variables of sheet 11.1 and the operators of sheet 11.1.1.

You must be able to:

- use the string functions **LENGTH**, **LEFT**, **RIGHT**, **MID**, **TO_UPPER** and **TO_LOWER**
- join strings with **&**, and convert between numbers and strings with **NUM_TO_STR** and **STR_TO_NUM**
- use **ASC**, **CHR**, **INT** and **RAND**
- work out an expression in which one function is inside another
- state the benefits of using a program library

1 Worked examples

Study these first. Each one shows a **method** that a question later on this sheet needs.

■ What a function is

A **function** takes values (its **parameters** 参数), does a job, and **returns** a result. The result **replaces** the call:

Size ← **LENGTH**("Computer") stores 8 in Size.

The exam gives this list on the insert: do not learn it by heart, but use the **exact names** and the **correct order** of the parameters.

■ The string functions

- Positions are counted from **1**, and a space counts as a character: **LENGTH**("Happy Days") is 10.
- **TO_UPPER** and **TO_LOWER** take a **CHAR** or a **STRING**. The Pseudocode Guide also has **UCASE** and **LCASE**, which take **one CHAR only**.

1 2 3 4 5 6 7 8
 s =

C	O	M	P	U	T	E	R
---	---	---	---	---	---	---	---

LENGTH(s) = 8 RIGHT(s, 2) = "ER"
 LEFT(s, 3) = "COM" TO_UPPER(s) = "COMPUTER"
 MID(s, 4, 3) = "PUT" TO_LOWER(s) = "computer"

function	returns	example
LENGTH(s)	the number of characters in s	LENGTH("Computer") is 8
LEFT(s, n)	the first n characters	LEFT("Computer", 3) is "Com"
RIGHT(s, n)	the last n characters	RIGHT("Computer", 2) is "er"
MID(s, start, n)	n characters, beginning at position start	MID("Computer", 4, 3) is "put"
TO_UPPER(x)	x in capital letters	TO_UPPER("hi") is "HI"
TO_LOWER(x)	x in small letters	TO_LOWER("Hi") is "hi"

■ Joining and converting

- The operator **&** **concatenates** 拼接 (joins) two strings: "Sum" & "mer" is "Summer".
- + does **not** join strings, and a number cannot be joined to a string. Convert it first:

function	returns	example
NUM_TO_STR(x)	the number x as a string	NUM_TO_STR(87.5) is "87.5"
STR_TO_NUM(s)	the string s as a number	STR_TO_NUM("23.45") is 23.45
IS_NUM(s)	TRUE if s is a valid number	IS_NUM("12a") is FALSE
ASC(c)	the ASCII code of the character c	ASC('A') is 65
CHR(n)	the character with the ASCII code n	CHR(66) is 'B'

"Total: " & Score is an error when Score is an INTEGER. The correct statement is
 "Total: " & NUM_TO_STR(Score).

■ Numeric functions

function	returns	example
INT(<i>x</i>)	the whole-number part of <i>x</i>	INT(27.5415) is 27
RAND(<i>n</i>)	a random real number from 0 up to, but not including, <i>n</i>	RAND(6) could be 4.27

RAND returns a real number, so a random **integer** needs INT. Dice, 1 to 6: INT(RAND(6)) gives 0 to 5, so add 1. From Low to High: INT(RAND(High - Low + 1)) + Low.

■ A function inside a function

Work from the **inside out**: work out the inner function first, and put its result in the outer one.

Worked example: TO_UPPER(RIGHT("Program", 2)).

1. Inner: RIGHT("Program", 2) is "am".
2. Outer: TO_UPPER("am") is "AM".

Worked example: LENGTH("Hello") + STR_TO_NUM("4"). LENGTH("Hello") is 5 and STR_TO_NUM("4") is 4, so the result is 9.

■ Program libraries

A **program library** 程序库 is a collection of routines that are already written, tested and compiled. Benefits of using one:

- it **saves time**: no new code to write and test
- the routines are already **tested**, so they are reliable
- they are written by **experts**, and may do a job the programmer could not write
- a routine can be **used many times**

2 Practice

Now use the methods above. The first questions need one idea each.

2.1 Name the function that does each job. [5]

- (a) returns the number of characters in a string
- (b) returns the last few characters of a string
- (c) changes a string into a number
- (d) returns the ASCII code of a character
- (e) returns the whole-number part of a real number

2.2 Give the value of each expression. [4]

- (a) `LENGTH("Computer")`
- (b) `RIGHT("Computer", 3)`
- (c) `MID("Computer", 4, 2)`
- (d) `INT(STR_TO_NUM("9.7"))`

2.3 The variable `Word` holds "Keyboard". Work out the value of each expression. [4]

(a) `LEFT(Word, 3)`

(b) `MID(Word, 4, 2)`

(c) `TO_UPPER(RIGHT(Word, 5))`

(d) `LENGTH(Word) DIV 3`

2.4 Work out the value of each expression. [4]

(a) `ASC('C')`, given that `ASC('A')` is 65

(b) `CHR(70)`

(c) `"AB" & "12"`

(d) `STR_TO_NUM("12") + 3`

2.5 Write the pseudocode statement that assigns to `Dice` a random integer from 1 to 6, and state why `INT` is needed. [2]

2.6 A student writes `Message ← "Total: " + Score`, where `Score` is an `INTEGER`. State what is wrong and write the correct statement. [2]

3 Exam-style questions

3.1 Give the value of each expression.

[3]

- (a) `TO_UPPER(RIGHT("Program", 2))`
 (b) `LENGTH(MID("Computer", 3, 4))`
 (c) `ASC('Q') - ASC('A')`

3.2 Complete each expression so that it evaluates to the value shown. Use only functions and operators from the insert. [4]

[4]

Expression	Evaluates to
..... ("Saturday", 3)	"Sat"
..... ('D')	68
2 * ("27")	54
MID("Notebook",,)	"book"

3.3 Write pseudocode that reads a word and outputs it in **capitals** followed by its **length**, using built-in functions. [3]

[3]

3.4 A school builds each student's username from their surname, their first name and their year group: the **first three letters of the surname in capitals**, then the **first letter of the first name**, then the **year group**.

Write a single pseudocode statement that assigns this username to `Username`, using the variables `Surname`, `FirstName` and `Year`, where `Year` is an `INTEGER`. [4]

[4]

3.5 State **three** benefits of using a program library rather than writing the routines yourself. [3]

3.6 A shop gives every product a code such as "TV-2025-0457". The code has three parts: two letters for the type of product, the year the product was first sold, and a product number. The code is stored in the variable `Code`.

(a) Work out the value of each expression when `Code` is "TV-2025-0457". [3]

Expression	Evaluates to
LEFT(<code>Code</code> , 2)	
STR_TO_NUM(MID(<code>Code</code> , 4, 4)) + 1	
LENGTH(<code>Code</code>) - 8	

(b) Write **one** pseudocode statement that stores the product number, as an `INTEGER`, in the variable `ProductNumber`. [3]

(c) The shop makes a short label from the code: the two letters in small letters, then the last two digits of the year. For "TV-2025-0457" the label is "tv25". Write **one** pseudocode statement that stores the label in the variable `Label`. [4]

Solutions

Each answer shows the steps, then the **result**.

2.1

- (a) **LENGTH**
- (b) **RIGHT**
- (c) **STR_TO_NUM**
- (d) **ASC**
- (e) **INT**

2.2

- (a) **8**
- (b) **"ter"**
- (c) **"pu"** – positions count from 1, so position 4 is the p
- (d) **9 – STR_TO_NUM** gives 9.7 and **INT** takes the whole-number part

2.3

- (a) the first three characters: **"Key"**
- (b) two characters from position 4: **"bo"**
- (c) the inner function first: **RIGHT(Word, 5)** is "board", so the result is **"BOARD"**
- (d) **LENGTH(Word)** is 8, and **8 DIV 3** is **2**

2.4

- (a) **'C'** is two letters after **'A'**: $65 + 2 = \mathbf{67}$
- (b) $70 - 65 = 5$ letters after **'A'**: **'F'**
- (c) **&** joins the strings: **"AB12"**
- (d) the string becomes the number 12, and $12 + 3 = \mathbf{15}$

2.5

- **Dice** $\leftarrow$ **INT(RAND(6)) + 1**
- **RAND** returns a **real** from 0 up to but not including 6, so **INT** is needed to make it a whole number; the **+ 1** shifts the range from 0-5 to 1-6

2.6

- **+** cannot join a string to an integer: the two are different types
- **Message** $\leftarrow$ **"Total: " & NUM_TO_STR(Score)** – **&** concatenates, and the number must be converted to a string first

3.1

- (a) the inner call runs first: **RIGHT("Program", 2)** is "am", so the answer is **"AM"**

(b) `MID("Computer", 3, 4)` is "mput", so `LENGTH` of it is **4**

(c) 'Q' is 81 and 'A' is 65, so the answer is **16**

3.2

- the first three characters → **LEFT**
- a character to its code → **ASC**
- the string "27" must become the number 27 → **STR_TO_NUM**
- "book" starts at position 5 and has 4 characters → **5, 4**

3.3

- `INPUT`, then `TO_UPPER` and `LENGTH`

```
OUTPUT "Enter a word:"  
INPUT Word  
OUTPUT TO_UPPER(Word)  
OUTPUT "Length: ", LENGTH(Word)
```

3.4

- `LEFT(Surname, 3)` for the first three letters
- `TO_UPPER(...)` around it: it accepts a whole string, whereas `UCASE` takes one `CHAR` and is not on the insert
- `LEFT(FirstName, 1)` for the initial
- `NUM_TO_STR(Year)`, and the three parts joined with `&`

```
Username ← TO_UPPER(LEFT(Surname, 3)) & LEFT(FirstName, 1) &  
↪ NUM_TO_STR(Year)
```

- for Surname "Chen", FirstName "Yuwei" and Year 12 this gives "CHEY12"

3.5 any three:

- the routines have already been written, compiled and **tested**, so they are less likely to contain errors
- they save development time, because the code does not have to be written again
- they may do things the programmer could not write themselves, such as complex statistics or graphics; they are written by experts; and a routine with a fixed interface can be called from anywhere in the program, and reused across many programs

3.6

(a) `LEFT(Code, 2)` → **"TV"**

- `MID(Code, 4, 4)` is "2025", which becomes the number 2025, and $2025 + 1 = \mathbf{2026}$
- `LENGTH(Code)` is 12, and $12 - 8 = \mathbf{4}$

(b) the last four characters hold the product number: `RIGHT(Code, 4)` (or `MID(Code, 9, 4)`)

- they are converted with `STR_TO_NUM`

- the result is assigned to ProductNumber: `ProductNumber ← STR_TO_NUM(RIGHT(Code, 4))`

(c) the two letters: `LEFT(Code, 2)`

- made small with `TO_LOWER`
- the last two digits of the year: `MID(Code, 6, 2)`
- the two parts joined with `&` and assigned: `Label ← TO_LOWER(LEFT(Code, 2)) & MID(Code, 6, 2)`