

6.1 Automated systems

Name: _____ Class: _____ Date: _____

Total: 27 marks

KEY WORDS sensor 传感器 • microprocessor 微处理器 • automated system 自动化系统
 • actuator 执行器 • a rogue value 哨兵值

Objective

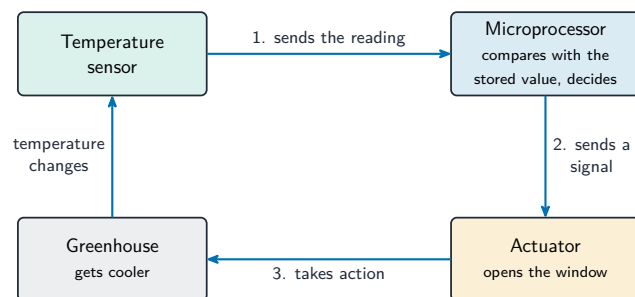
Build the skills to answer exam questions on **automated systems** 自动化系统 — the roles of **sensors** 传感器, **microprocessors** 微处理器 and **actuators** 执行器, and the pros and cons.

You must be able to:

- describe the role of the sensor, microprocessor and actuator
- describe the control loop
- give advantages and disadvantages of automated systems

1 Worked examples

■ The control loop



Sensor reads data → microprocessor compares with stored values → signals actuator → the loop repeats

- **sensor:** measures a quantity; **microprocessor:** decides; **actuator:** causes action.

■ Algorithms: what each one is for

Pseudocode or flowchart? Both describe the same algorithm. Pseudocode is quicker to write and translates straight into code; a flowchart shows the flow of control visually and is easier to follow at a glance.

The standard methods the exam expects:

- **totalling** 求和: $Total \leftarrow Total + Value$ inside the loop, with $Total \leftarrow 0$ before it.
- **counting** 计数: $Count \leftarrow Count + 1$ each time a condition is met.
- **finding the largest:** set **Largest** to the first value (or a very small number), then replace it whenever a bigger value appears.
- **finding the smallest:** the same with the comparison reversed.
- **calculating an average:** total divided by the count, after the loop.
- **a rogue value** 哨兵值: a value outside the possible data that stops the loop, such as -1 for a mark out of 100. Test for it before adding, or the rogue value joins the total.

Worked example. Input marks until -1 is entered, then output the total and the average.

```

Total ← 0
Count ← 0
INPUT Mark
WHILE Mark <> -1 DO
    Total ← Total + Mark
    Count ← Count + 1
    INPUT Mark
ENDWHILE
IF Count > 0
    THEN
        OUTPUT "Total ", Total
        OUTPUT "Average ", Total / Count
    ELSE
        OUTPUT "No marks entered"
ENDIF
  
```

Two details earn marks: the first **INPUT before** the loop so the condition can be tested, and the check that **Count** is not zero before dividing.

Trace tables. Draw one column per variable and one per output, then work through the algorithm one line at a time, writing each new value on a new row. Never rub out an old value: the examiner wants to see the sequence.

2 Practice

2.1 State the role of a sensor in an automated system. [1]

2.2 State the role of an actuator. [1]

2.3 State what a rogue value is and give one example. [2]

2.4 Give the line of pseudocode that adds **Mark** to a running total. [1]

2.5 Explain why the total must be set to zero before the loop begins. [2]

3 Exam-style questions

3.1 In an automated greenhouse, the part that decides whether to open a window is the: [1]

- A

B

C

D
- A sensor

B microprocessor

C actuator

D window

3.2 A greenhouse is too hot.

(a) Describe the steps the system takes to cool it. [3]

(b) State one disadvantage of automated systems. [1]

3.3 A program inputs the temperatures recorded each day until the rogue value **−99** is entered.

(a) State why **−99** is a suitable rogue value here. [1]

(b) Write pseudocode that inputs the temperatures, and outputs the total, the average and the highest temperature. [7]

(c) Explain why the program must check the count before calculating the average. [2]

(d) Complete the trace table for the input data 12, 15, 9, **−99**. [4]

Mark	Total	Count	Highest	OUTPUT
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(e) Give one advantage of writing this algorithm as a flowchart rather than as pseudocode. [1]
