

6.2 Robotics

Name: _____ Class: _____ Date: _____

Total: 25 marks

KEY WORDS robots 机器人 • robotics 机器人技术 • mechanical 机械的 • electrical components 电子元件
• flowchart 流程图

Objective

Build the skills to answer exam questions on **robotics** 机器人技术 — the characteristics of a robot, what robots do, and their limitations.

You must be able to:

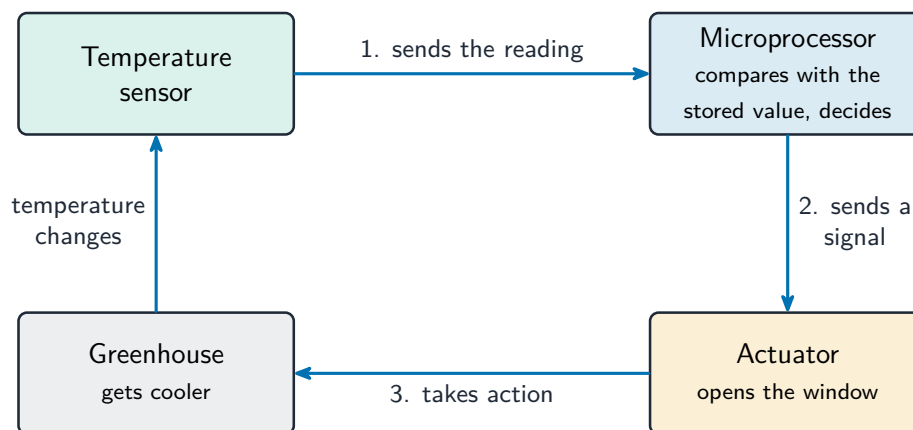
- give the characteristics of a robot
- give examples of robot roles
- discuss advantages and the key limitation (no independent decisions)

1 Worked examples

■ Robots



A robot has a physical structure, electrical components, and programmable instructions



A robot senses, processes and acts in a control loop

- **roles:** factory equipment (welding, moving parts), domestic (robot vacuum).
- **key limit:** a robot cannot think for itself — it only does what it is programmed to do.

■ Reading a flowchart, and the difference between the three system types

A **flowchart** 流程图 uses a fixed set of shapes: an oval for start and stop, a parallelogram for input and output, a rectangle for a process, and a diamond for a decision with a labelled Yes and No branch. Every path must reach a stop.

Automated, monitoring, control. A **monitoring** system reads sensors and only reports or warns; a **control** system reads sensors and acts to change what is happening; an **automated** system combines both to run a whole task without a person. The exam wants the loop named in order: sensor sends readings continuously, ADC converts them, the microprocessor compares each with a stored value, and it acts or does not act, then the cycle repeats.

Worked example (a heating system). Describe the process. The temperature sensor sends readings continuously; the ADC converts each to digital; the microprocessor compares the reading with the stored value; if the reading is below it, the microprocessor sends a signal to switch the heater on; if it is above, it switches the heater off; the process repeats. Because the microprocessor acts on the reading, this is a control system, not merely monitoring.

Where each is used. Monitoring: a patient's heart rate in a hospital, a burglar alarm, pollution measurement. Control: central heating, a greenhouse, traffic lights, a chemical process. Automated: a robotic production line, a self-driving vehicle.

2 Practice

2.1 State two characteristics of a robot. [2]

2.2 Give one example of a robot used in the home. [1]

2.3 Identify the flowchart shape used for a decision, and for an input. [2]

2.4 Explain the difference between a monitoring system and a control system. [2]

2.5 Give one example each of a monitoring system and a control system. [2]

3 Exam-style questions

3.1 A key limitation of a robot is that it: [1]

- **A** never breaks down
- **B** cannot make independent decisions
- **C** works for free
- **D** gets tired

3.2 A factory uses robot arms on a production line.

(a) State two advantages of using robots here. [2]

(b) State one disadvantage of using robots. [1]

3.3 A chemical process must be kept between 30 °C and 35 °C. A microprocessor reads a temperature sensor and switches a cooler on and off.

(a) Describe how the microprocessor uses the sensor readings to keep the temperature in range. [5]

(b) Explain why this is a control system and not a monitoring system. [2]

(c) State the purpose of the analogue-to-digital converter in this system. [1]

(d) The process must also raise an alarm if the temperature goes above 40 °C. Describe the extra comparison the microprocessor makes, and the shape a flowchart would use for it. [2]

(e) Give two advantages of using a microprocessor rather than a person to control this process. [2]

Solutions

2.1 any two of: a physical (mechanical) structure; electrical components; programmable instructions.

2.2 a robotic vacuum cleaner.

3.1 B. A robot cannot make independent decisions.

3.2 (a) any two of: do dull/dangerous jobs; work quickly and accurately; do not tire/bore.
(b) any of: expensive to buy/maintain; can replace human workers; cannot make its own decisions.

2.3 A diamond for a decision; a parallelogram for an input.

2.4 A monitoring system only reads and reports the data, or gives a warning; a control system also sends signals that change the process.

2.5 Monitoring: a patient's heart rate in hospital, a burglar alarm, or pollution measurement. Control: central heating, a greenhouse, traffic lights, or an automatic door.

3.3 (a) The temperature sensor sends readings continuously; the ADC converts each reading to digital; the microprocessor compares the reading with the stored values of 30 °C and 35 °C; if the reading is above 35 °C it sends a signal to switch the cooler on, and if it falls below 30 °C it switches the cooler off; the process repeats continuously.

(b) The microprocessor does not only record the readings: it sends signals that switch the cooler and so change the temperature itself, which is what makes it a control system.

(c) It converts the sensor's analogue signal into digital values the microprocessor can process.

(d) The microprocessor also compares each reading with the stored value of 40 °C and, if the reading is greater, sends a signal to sound the alarm; a flowchart would show this as a decision, drawn as a diamond with Yes and No branches.

(e) Any two of: it reacts far faster than a person; it never gets tired or distracted, so it works continuously; it is more accurate and consistent; it can work in conditions unsafe for people.