

Exercise walk-through

Robotics ■ 6.2

eXercise

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)

Method — Robots

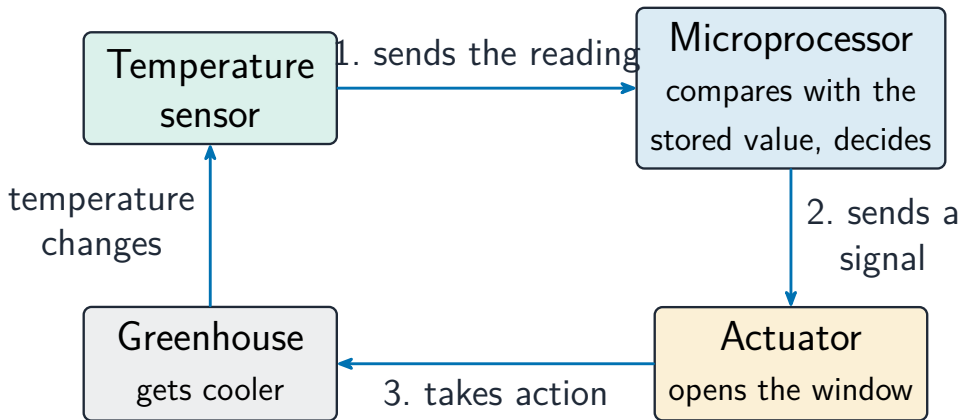
- **roles:** factory equipment (welding, moving parts), domestic (robot vacuum).
- **key limit:** a robot cannot think for itself — it only does what it is programmed to do.

Method — Robots



An industrial robot arm

Method — Robots



A robot senses, processes and acts in a control loop

Method — 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

Method — Reading a flowchart, and the difference between the three system types

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.

Practice 2.1 ■ 2 marks

State two characteristics of a robot.

Solution 2.1

Worked steps

any two of: a physical (mechanical) structure; electrical components; programmable instructions **B1** **B1**.

Practice 2.2 ■ 1 mark

Give one example of a robot used in the home.

Solution 2.2

Method: Reading a flowchart, and the difference between the three system types

Worked steps

a robotic vacuum cleaner **B1**.

Practice 2.3 ■ 2 marks

Identify the flowchart shape used for a decision, and for an input.

Solution 2.3

Method: Reading a flowchart, and the difference between the three system types

Worked steps

A diamond for a decision **B1**; a parallelogram for an input **B1**.

Practice 2.4 ■ 2 marks

Explain the difference between a monitoring system and a control system.

Solution 2.4

Method: Reading a flowchart, and the difference between the three system types

Worked steps

A monitoring system only reads and reports the data, or gives a warning **B1**; a control system also sends signals that change the process **B1**.

Practice 2.5 ■ 2 marks

Give one example each of a monitoring system and a control system.

Solution 2.5

Method: Reading a flowchart, and the difference between the three system types

Worked steps

Monitoring: a patient's heart rate in hospital, a burglar alarm, or pollution measurement **B1**. Control: central heating, a greenhouse, traffic lights, or an automatic door **B1**.

Exam-style 3.1 ■ 1 mark

A key limitation of a robot is that it:

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

Solution 3.1

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

Worked steps

- B.** A robot cannot make independent decisions.

Exam-style 3.2 ■ 2 marks

A factory uses robot arms on a production line.

- (a) State two advantages of using robots here.
- (b) State one disadvantage of using robots.

Solution 3.2

Worked steps

- (a) any two of: do dull/dangerous jobs; work quickly and accurately; do not tire/bore **B1** **B1**.
- (b) any of: expensive to buy/maintain; can replace human workers; cannot make its own decisions **B1**.

Exam-style 3.3 ■ 5 marks

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.
- (b) Explain why this is a control system and not a monitoring system.
- (c) State the purpose of the analogue-to-digital converter in this system.
- (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.
- (e) Give two advantages of using a microprocessor rather than a person to control this process.

Solution 3.3

Method: Reading a flowchart, and the difference between the three system types

Worked steps

(a) The temperature sensor sends readings continuously (B1); the ADC converts each reading to digital (B1); the microprocessor compares the reading with the stored values of 30 °C and 35 °C (B1); 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 (B1); the process repeats continuously (B1).

(b) The microprocessor does not only record the readings: it sends signals that switch the cooler and so change the temperature itself (B1), which is what makes it a control system (B1).

Solution 3.3

- (c) It converts the sensor's analogue signal into digital values the microprocessor can process **B1**.
- (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 **B1**; a flowchart would show this as a decision, drawn as a diamond with Yes and No branches **B1**.
- (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 **B2**.