

- 1** A flower shop has a room that has an air-conditioning system. It is used to keep the room at a constant temperature for storing flowers.

The owner uses a keypad to set the temperature for the room.

- (a)** Tick (✓) **one** box to show whether a keypad is an example of an input, output, process or storage device.

A	input	☐
B	output	☐
C	process	☐
D	storage	☐

[1]

- (b)** The owner of the shop enters a denary number to set the temperature for the room.

The denary number is converted to a binary number to be processed. The binary number is stored in a register in the air conditioning system.

- (i)** Give the binary number that would be stored when the denary number 24 is entered.

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- (ii)** Give the binary number that would be stored when the denary number 101 is entered.

..... [1]

- (iii)** The binary number 00010011 is stored in the register.

Give the denary number that has been entered for this binary number to be stored.

..... [1]

- (iv)** The binary number 00100010 is stored in the register.

Give the denary number that has been entered for this binary number to be stored.

..... [1]

Working space

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- (c)** If the air-conditioning system detects an error, it displays an error code. The error code is displayed as a hexadecimal number. The binary number for each error code is stored in a register.

- (i)** Give the binary number that is stored in the register to display the error code 51.

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- (ii)** Give the binary number that is stored in the register to display the error code E3.

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- (iii)** Give the hexadecimal number that is displayed when the binary number 10000010 is stored in the register.

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- (d)** If the owner of the shop wants to make the room very cold, she may need to enter a negative denary number.

The negative denary number could be represented using two's complement.

Give the two's complement 8-bit binary integer that would be stored for the temperature −5.

Show all your working.

Working space

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Two's complement 8-bit binary integer

[2]

(e) The air-conditioning system uses a temperature sensor and a microprocessor to keep the temperature of the room at a constant level.

(i) Tick (✓) **one** box to show whether the sensor is an example of an input, output, process or storage device.

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|------------------|--------------------------|
| A input | ☐ |
| B output | ☐ |
| C process | ☐ |
| D storage | ☐ |

[1]

(ii) The temperature sensor continuously sends analogue data to the microprocessor. This data is then converted to digital.

Explain how the microprocessor keeps the temperature of the room at a constant level.

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(f) The air-conditioning system is an example of an embedded system.

Explain why the air-conditioning system is an embedded system.

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6 A weather station uses automated systems to collect and analyse data about the weather.

The automated system uses sensors.

(a) Give **one** other component that would be part of the automated system.

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(b) One sensor that is part of the automated system is a temperature sensor.

Give **one** other sensor that could be part of the automated system.

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(c) An alert is sent to an employee in the weather office if a temperature above 40 °C is detected.

(i) Explain how a temperature above 40 °C is detected for the alert.

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(ii) The data for the alert is sent using serial simplex data transmission.

Explain how the data is sent using serial simplex data transmission.

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- (d) Give **two** advantages to the weather station employees of using an automated weather system.

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- (e) Give **one** disadvantage to the weather station employees of using an automated weather system.

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[1]

- (f) The automated weather system is upgraded and given machine learning capabilities.

- (i) Machine learning is part of a branch of computer science.

Identify the name of this branch of computer science.

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- (ii) Explain how the machine learning capabilities can be used to predict future weather.

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[3]

- 5 A farmer has a plough that is an automated system. The plough is used to dig the ground in a field to prepare it for planting seeds.

The plough uses sensors and a microprocessor to maintain a straight line when digging the ground.

- (a) State what is meant by an automated system.

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- (b) Describe the role of the microprocessor in this process.

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- (c) Give **two** benefits to the farmer of using an automated system for this purpose.

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- (d) The plough uses artificial intelligence (AI) to navigate its way around the field.

Explain how the plough makes use of AI for this purpose.

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[4]

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(ii) Another method of error checking is a parity block check.

The table shows 7 bytes that are transmitted using odd parity. The parity bit has been completed for each byte.

Complete the parity byte for the data.

	parity bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
byte 1	1	1	0	0	1	1	1	0
byte 2	1	0	0	0	0	1	1	0
byte 3	0	1	0	0	0	0	0	0
byte 4	0	1	0	0	1	1	1	1
byte 5	1	0	0	0	0	0	0	0
byte 6	0	1	1	1	1	1	1	1
byte 7	1	1	0	0	1	1	0	1
parity byte								

[3]

11 A manufacturing company uses an automated system in its manufacturing process.

(a) The automated system uses a flow sensor.

Identify what a flow sensor measures.

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(b) Explain **one** advantage to employees of using an automated system in manufacturing.

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(c) Explain **one** disadvantage to the company owner of using an automated system in manufacturing.

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The system uses a sensor and a microprocessor.

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