6.1 – 6.3 Automated & Emerging Technologies
QUESTIONS

6 – Automated and emerging technologies

6.1 Automated systems				
1	Describe how sensors, microprocessors and actuators can be used in collaboration to create automated systems			
2	Describe the advantages and disadvantages of an automated system used for a given scenario			

More Guidance:

6.1 Automated systems

Candidates should be able to:	Notes and guidance
1 Describe how sensors, microprocessors and actuators can be used in collaboration to create automated systems	
2 Describe the advantages and disadvantages of an automated system used for a given scenario	• Including scenarios from: – industry – transport – agriculture – weather – gaming – lighting – science

6.2 Robotics				
1	Understand what is meant by robotics			
2	Describe the characteristics of a robot			
3	Understand the roles that robots can perform and describe the advantages and disadvantages of their use			

More Guidance:

6.2 Robotics

Candidates should be able to:	Notes and guidance
1 Understand what is meant by robotics	• Robotics is a branch of computer science that incorporates the design, construction and operation of robots • Examples include factory equipment, domestic robots and drones
2 Describe the characteristics of a robot	• Including: – a mechanical structure or framework – electrical components, such as sensors, microprocessors and actuators – programmable
3 Understand the roles that robots can perform and describe the advantages and disadvantages of their use	• Robots can be used in areas including: – industry – transport – agriculture – medicine – domestic – entertainment

6.1 – 6.3 Automated & Emerging Technologies
QUESTIONS

6.3 Artificial Intelligence				
1	Understand what is meant by artificial intelligence (AI)			
2	Describe the main characteristics of AI as the collection of data and the rules for using that data, the ability to reason, and can include the ability to learn and adapt			
3	Explain the basic operation and components of AI systems to simulate intelligent behaviour			

More Guidance:

6.3 Artificial intelligence

Candidates should be able to:	Notes and guidance
1 Understand what is meant by artificial intelligence (AI)	• AI is a branch of computer science dealing with the simulation of intelligent behaviours by computers
2 Describe the main characteristics of AI as the collection of data and the rules for using that data, the ability to reason, and can include the ability to learn and adapt	
3 Explain the basic operation and components of AI systems to simulate intelligent behaviour	• Limited to: – expert systems – machine learning • Expert systems have a knowledge base, a rule base, an inference engine and an interface • Machine learning is when a program has the ability to automatically adapt its own processes and/or data

6.1 – 6.3 Automated & Emerging Technologies
QUESTIONS

10 A business has a system that is described as having artificial intelligence (AI).

(a) State **one** of the main characteristics of an AI system.

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(b) An AI system is an expert system.

Explain how an expert system operates.

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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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..... [1]

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

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..... [2]

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

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10 A car repair garage uses an expert system.

(a) Complete the description about the operation of the expert system.

Use the terms from the list. Some of the terms in the list will **not** be used.

inference engine interface knowledge base

machine learning mechanical engine output device

question base rule base

An expert system has a ..... that contains a list of facts. The ..... applies the ..... to the ..... to reach a diagnosis for the repair of the car. The user provides data to the system using an ..... . [5]

9 A company uses robots in its factory to manufacture large pieces of furniture.

(a) One characteristic of a robot is that it is programmable.

State **two** other characteristics of a robot.

1 .....

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2 .....

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[2]

(b) Give **two** advantages to company employees of using robots to manufacture large pieces of furniture.

1 .....

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2 .....

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[2]

(c) Give **one** disadvantage to the company's owners of using robots to manufacture large pieces of furniture.

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6.1 – 6.3 Automated & Emerging Technologies
QUESTIONS

9 One component of an expert system is the inference engine.

(a) Identify the **three** other components in an expert system.

1 .....

2 .....

3 .....
[3]

(b) Describe the role of the inference engine in an expert system.

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7 The rule base and the inference engine are two components of an expert system.

(a) Identify the other **two** components of an expert system.

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2 .....
[2]

(b) Describe the role of the rule base in an expert system.

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6 A company is involved in robotics.

One of its robots is designed to make a specific movement depending on a binary value.

(a) The table gives some of the movements for the robot.

Complete the table by writing the missing binary, denary or hexadecimal value for each movement.

Movement	Binary	Denary	Hexadecimal
forward 1 step	00011111	31	
back 1 step		140	8C
turn right	01011010		5A
turn left		120	78

[4]

Working space

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(b) Describe what is meant by robotics.

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(c) The robot has a sensor and a microprocessor.

The robot will move forward continuously until it detects an object that is less than or equal to 10 cm in front of it.

If an object is less than or equal to 10 cm in front of it, the robot turns 90 degrees right. It then tries to move forward again.

Explain how the sensor and the microprocessor are used to automate this robot.

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(d) The robot needs to find its way through different puzzles. Each puzzle has a series of paths that the robot needs to follow to find its way to the end of the puzzle. The puzzle contains dead ends and obstacles, so the robot needs to decide which way to go.

The robot's program will use artificial intelligence (AI).

(i) Describe the characteristics of AI.

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(ii) Explain how the program will use AI.

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2 An automated water tap system uses a sensor and a microprocessor to operate. Water flows from the tap when a person's hands are placed underneath the tap. Water stops flowing when the person's hands are removed from underneath the tap.

(a) Explain how the water tap system uses a sensor and a microprocessor to operate.

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(b) **Three** descriptions are shown of different systems.

Identify the most suitable sensor that could be used in each system.

Description of system	Sensor
it checks the air is dry enough in a garage that spray paints cars	
it automatically switches on the headlights on a car when it is dark	
it checks that the soil in a greenhouse has the correct level of acidity	

[3]

6 A business uses a closed-circuit television (CCTV) system that starts recording when motion is detected. It stops recording after two minutes if no further motion is detected. The system uses a motion sensor and a microprocessor.

Describe how the motion sensor and microprocessor work together to control the CCTV system.

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9 A washing machine uses sensors and a microprocessor to control the washing cycle of clothes.

(a) A sensor is used in each of the given tasks.

Identify **one** suitable sensor that would be used for each task.

Each sensor given must be different.

Task	Sensor
checking the water is 30 °C	
checking the water acidity level after detergent is added	
checking the weight of the clothes to make sure that the machine is **not** overloaded	

[3]

(b) Describe how the sensor and the microprocessor are used to make sure the water remains at 30 °C.

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8 An electronic game has **three** square mats that are coloured red, green and blue.

The player will see a colour displayed on a screen and has 1 second to hit the mat that matches the colour. If the player hits the correct mat, within 1 second, a counter is incremented. When a player hits an incorrect mat, the game ends.

The game uses sensors and a microprocessor to determine if the player hits the correct mat within 1 second.

Explain how the game uses sensors and a microprocessor to count the number of times a player hits a correct mat within 1 second.

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5 Jamelia has a greenhouse that she uses to grow fruit and vegetables. She needs to make sure the temperature in the greenhouse stays between 25 °C and 30 °C (inclusive).

A system that has a temperature sensor and a microprocessor is used to maintain the temperature in the greenhouse. The system will:

- open a window and turn a heater off if it gets too hot
- close a window and turn a heater on if it gets too cold.

Describe how the system uses the temperature sensor and the microprocessor to maintain the temperature in the greenhouse.

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9 An underground car park has a system that checks the height of vehicles. A vehicle can be no higher than 1.8 metres to enter the car park.

The system also counts the number of vehicles that have entered the car park, so that it can display how many parking spaces are still available.

Each parking space has a red and a green light above it. If a car is parked in the parking space only the red light is on, otherwise only the green light is on.

Sensors and a microprocessor are used to control the system.

(a) Complete the table to identify a suitable sensor for each part of the system.

Task	Sensor
check if a vehicle is too high	
count the vehicles entering the car park	
check if a vehicle is parked in a parking space	

[3]

(b) Describe how the sensor and the microprocessor are used to display the red or green light above the parking space.

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