MODULE J HARDWARE AND EMERGING TECH · J4

Automated systems: mark scheme

22 marks · Cambridge 0478 syllabus 6.1.1 (describe how sensors, microprocessors and actuators are used in collaboration to create automated systems; scenarios from industry, transport, agriculture, weather, gaming, lighting, science) and 6.1.2 (describe the advantages and disadvantages of an automated system used for a given scenario)

How to use. One mark per creditworthy point up to the maximum shown. **/** separates alternative words; **//** separates alternative answers. Words in (brackets) are not needed for the mark. "..." at the start of a point means it builds on the point before. Credit any other valid answer that shows the same understanding. Vague answers such as "it is faster", "it is cheaper" or "it is safer" on their own, with no reason, are not credited.

QUESTION	ANSWER	MARKS	GUIDANCE
1 0478 6.1.1	One mark for each correct row: Measures the amount of water in the soil: Sensor Compares a reading with a stored value and decides: Microprocessor Opens a valve when it receives a signal: Actuator Takes readings of the air pressure and sends them: Sensor	**4**	A row with more than one tick scores 0.
2 0478 6.1.1	Any two from: The (light) sensor only measures / detects the light level // only takes readings ... and sends the readings / data to the microprocessor The microprocessor compares the reading with a stored value // decides whether it is dark enough The microprocessor sends a signal to the actuator The actuator switches the floodlights on (not the sensor)	**2**	max 2. Do not accept "the sensor cannot switch things on" with no reference to what the sensor does or what does the switching.
3 0478 6.1.1	One mark for each correct word, in this order: continuously microprocessor compares actuator	**4**	Accept a grammatical variant of the correct word (e.g. "compare"). Do not accept words that are not in the list.

QUESTION	ANSWER	MARKS	GUIDANCE
4(a) 0478 6.1.2	Two marks per advantage: one for the advantage, one for the expansion in context. Any two from: It monitors the gas level 24 hours a day // all the time // without breaks ... so a dangerous gas level is not missed between employees' checks / at night It responds faster / immediately (when the gas level is too high) ... so the fans start sooner // harmful gas has less time to build up // drivers are exposed for less time Employees no longer need to walk through the tunnel ... so they are not exposed to the harmful exhaust gases / to traffic // it is safer for employees Readings / decisions are more consistent / accurate // there is no human error (e.g. misreading a meter, forgetting to switch on the fans) ... so the fans are switched on every time the level is too high Fewer employees are needed (to check the tunnel) ... so the cost of wages / labour (for the tunnel operator) is lower // employees can do other work Sensors can be placed all along the tunnel / take readings at many points at the same time ... so a high gas level anywhere in the tunnel is detected	**4**	max 4: max 2 per advantage. The expansion mark must follow from its own advantage. Two answers that make the same point score once. "Safer", "faster" or "cheaper" alone, with no reason, is not credited.
4(b) 0478 6.1.2	One mark for the disadvantage, one for the expansion in context. Any one pair from: It is expensive to buy / set up / install // to maintain / repair ... for example the sensors and fans need regular checks / calibration / replacing A sensor / the system could fail / malfunction / lose power ... so the fans are not switched on and harmful gas builds up // drivers / people in the tunnel are put at risk The system could be hacked // attacked ... and the fans switched off / the readings changed, putting people in the tunnel at risk Employees who checked the tunnel may lose their jobs ... so they need to find other work // need retraining (e.g. to maintain the system) It cannot deal with situations it was not programmed for ... such as a fire / crash / smoke, which may need a different response	**2**	max 2. The second mark must expand the disadvantage given. "It might break" with no consequence scores 1.

QUESTION	ANSWER	MARKS	GUIDANCE
5 0478 6.1.1	Any six from: The temperature sensor takes readings (of the temperature inside the incubator) ... continuously // at regular intervals The sensor sends the readings / data to the microprocessor The microprocessor compares each reading with stored values // with 36.5 °C and 37.5 °C // with the stored range If the reading is below 36.5 °C, the microprocessor sends a signal to the actuator to switch the heater on If the reading is above 37.5 °C, the microprocessor sends a signal to the actuator to switch the cooling fan on ... and the heater off // (when below 36.5 °C) the cooling fan off If the reading is within the range, no action is taken // the heater and fan stay off // the microprocessor waits for the next reading The process repeats (continuously) // it is a continuous loop // the system keeps monitoring and correcting (Analogue) readings are converted to digital (by an ADC) before the microprocessor processes them	**6**	max 6. The sensor must not be described as switching the heater or fan, and the actuator must not be described as taking readings. Do not credit "the sensor controls the temperature". Accept "too cold" / "below the range" and "too hot" / "above the range" in place of the temperatures in the heater and fan points. Reversed actions (fan on when too cold, heater on when too hot) score 0 for those points.

Total: 22 marks