MODULE J HARDWARE AND EMERGING TECH · J5

Robotics: mark scheme

20 marks · Cambridge 0478 syllabus 6.2.1 (what is meant by robotics), 6.2.2 (the characteristics of a robot: a mechanical structure or framework; electrical components such as sensors, microprocessors and actuators; programmable) and 6.2.3 (the roles robots perform in industry, transport, agriculture, medicine, domestic settings and entertainment, and the advantages and disadvantages of their use)

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. Credit any other valid answer that shows the same understanding. Vague answers such as "it is better", "it is faster" or "it is cheaper" with no reason or context are not credited.

QUESTION	ANSWER	MARKS	GUIDANCE
1 0478 6.2.1, 6.2.2	One mark for each correct row: Robotics is a branch of computer science ... design, construction and operation of robots: **True** A machine can only be a robot if it is shaped like a human: **False** A robot follows a stored program, which can be changed ...: **True** In a robot, the actuators take readings from the surroundings ...: **False**	**4**	A row with both boxes ticked scores 0 for that row. Row 4 is false because sensors take readings; actuators carry out the movement / action.
2(a) 0478 6.2.2	One mark for each row, in context: **Mechanical structure or framework:** the jointed arm // the joints of the arm // the (metal) frame / body / base // the part that holds the nozzle **Electrical components:** a microprocessor (that controls the arm / runs the program) // sensor(s), e.g. a proximity sensor / camera, to detect the cake // actuators / (electric) motors that move the arm / joints // a pump / valve that pushes out the icing	**2**	The answer must describe a part of this robot, not repeat the characteristic. Do not credit the conveyor belt or the cakes for the mechanical structure. For row 2, naming one correct electrical component of the robot is enough.
2(b) 0478 6.2.2	Any two from: The robot follows a (stored) program // set of instructions (to pipe the pattern) The program can be changed // the robot can be reprogrammed // a new program can be loaded for the new pattern ... so the same robot can be used // no new robot / machine needs to be bought // no hardware / parts need to be changed The change can be made quickly // production only stops for a short time The new pattern is then piped exactly the same on every cake // consistently / precisely	**2**	max 2. "It can be programmed" alone repeats the question and is not credited.

QUESTION	ANSWER	MARKS	GUIDANCE
3 0478 6.2.2 (also 6.1.1)	Any four from: The proximity sensor takes readings // detects how near an object is (to the nozzle) The sensor sends the data / readings to the microprocessor Analogue data from the sensor is converted to digital (by an ADC) The microprocessor compares the reading with a stored / pre-set value // checks whether the reading shows a cake is (directly) under the nozzle If a cake is in position, the microprocessor sends a signal to the actuators ... the actuators (e.g. motors / pump / valve) start piping // move the arm / nozzle If there is no cake // the reading is outside the set range, no signal is sent // the actuators do not start // the robot waits The process repeats (continuously) // the sensor keeps taking readings	**4**	max 4. Do not credit "the sensor controls the actuators" or "the sensor decides": the microprocessor makes the decision. Do not credit "the microprocessor measures the distance".
4 0478 6.2.3	One mark for each correct row: Picks ripe strawberries in a greenhouse: **agriculture** Model dinosaur in a theme park: **entertainment** Driverless shuttle between airport terminals: **transport** Cuts the grass in the garden of a house: **domestic settings**	**4**	Accept "domestic" for domestic settings. Industry and medicine are not used. If more than one area is written in a row, that row scores 0.
5(a) 0478 6.2.3	One mark for an advantage and one mark for an expansion linked to it, in context. For example: The technician does not need to climb the turbine // work at height // the drone works in the dangerous place instead ... so there is less risk of the technician falling / being injured The drone can check the blades more quickly ... so more turbines can be checked in a day // each turbine is out of action for less time The drone can work at any time // without breaks // for long periods ... so checks can be done more often The drone takes the same images in the same way every time // is consistent / precise ... so damage is less likely to be missed // images can be compared between checks Lower labour / running costs over time ... because fewer technicians need to be paid to climb (the turbines)	**2**	max 2. The second mark must expand the advantage given. Credit any other valid advantage. "Cheaper" or "faster" alone is not credited.

QUESTION	ANSWER	MARKS	GUIDANCE
5(b) 0478 6.2.3	One mark for a disadvantage and one mark for an expansion linked to it, in context. For example: The drone is expensive to buy // to maintain / repair ... so there is a high initial cost for the company // staff need training to use it Technicians may lose their jobs // fewer technicians are needed ... so staff may need retraining // the company may need to make staff redundant The drone cannot deal with unfamiliar situations // only does what it is programmed to do ... so it may miss / not recognise an unusual type of damage that a technician would notice The drone cannot repair the damage ... so a technician still has to climb the turbine to fix it The drone may not be able to fly in strong wind / bad weather // has a limited battery life ... so checks may be delayed // it cannot check many turbines on one charge The drone may malfunction // crash into a blade ... and damage the turbine / drone	**2**	max 2. The second mark must expand the disadvantage given. Credit any other valid disadvantage. "It might break" alone is not credited.

Total: 20 marks