MODULE J HARDWARE AND EMERGING TECH · J3

Sensors and what they measure: mark scheme

22 marks · Cambridge 0478 syllabus 3.2.3(a) (what is meant by a sensor and the purposes of sensors) and 3.2.3(b) (the data each sensor captures, when each is used, and selecting the most suitable sensor for a given context; sensors limited to acoustic, accelerometer, flow, gas, humidity, infra-red, level, light, magnetic field, moisture, pH, pressure, proximity, temperature)

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. A sensor must be named by its type from the syllabus list; "motion sensor" is not precise enough and is not credited.

QUESTION	ANSWER	MARKS	GUIDANCE
1(a) 0478 3.2.3(a)	Any two from: An input device that measures / detects a physical property // quantity // by example (e.g. temperature, light, sound) of its surroundings / environment captures data and sends it to a computer / microprocessor (to be processed)	**2**	max 2. Do not accept "an output device" or "a device that controls / moves something" (that is an actuator).
1(b) 0478 3.2.3(a)	Any two from: To capture / collect data about the environment // to monitor conditions (e.g. temperature of a room) To take readings automatically // without a person needing to be present To take readings continuously // at regular intervals // over a long period To provide (input) data for a computer / microprocessor / automated system to process or act on // so a system can respond to changes To take readings in places that are dangerous / difficult for people to reach To take readings more accurately / more often than a person could	**2**	max 2. Credit any other valid purpose. Two answers that make the same point (e.g. "monitor temperature" and "monitor light") score 1.
2 0478 3.2.3(b)	One mark for each correct line: pH → How acidic or alkaline a substance is proximity → How near an object is to the sensor flow → The rate at which a liquid or gas moves through a pipe acoustic → The level of sound	**4**	A sensor with more than one line drawn from it scores 0 for that sensor. "The height of a liquid in a container" (level) is not used.

QUESTION	ANSWER	MARKS	GUIDANCE
3 0478 3.2.3(b)	One mark for each row: Water dropped below a marked height: level (sensor) Water warm enough for tropical fish: temperature (sensor) Brightness of the lamps: light (sensor) Carbon dioxide in the air: gas (sensor)	**4**	Accept carbon dioxide / CO_2 sensor for gas. Do not credit pressure for row 1, infra-red for row 2 or humidity for row 4: the question asks for the most suitable sensor. If the same sensor is given in two rows, credit it only in the row where it is correct.
4(a) 0478 3.2.3(b)	Accelerometer	**1**	Do not accept motion sensor, pressure or proximity.
4(b) 0478 3.2.3(b)	Any two from: It measures acceleration // changes in speed / direction of movement A drop / shake causes a sudden / large change in acceleration // movement that it detects / records It measures tilt / orientation // the angle of the box ... so it can detect that the box has been tipped over It detects the movement of the box itself // it needs nothing outside the box to detect a drop	**2**	max 2. If 4(a) is not an accelerometer, 4(b) scores 0. Do not accept "it detects movement" alone with no link to the drop, shake or tilt.
5 0478 3.2.3(b)	One mark for a suitable sensor: Magnetic field // proximity // infra-red (sensor) Then any two from, linked to the sensor named: **Magnetic field:** the metal (body) of a car changes the magnetic field above the sensor // the sensor detects this change when a car is over it // the change ends when the car leaves **Proximity:** detects that an object is close above it // how near the underside of the car is // nothing near means the space is free **Infra-red:** the underside of the car reflects / blocks infra-red (sent up from the sensor) // no reflection means the space is free **Any sensor:** it works without a person checking // it gives a reading for each space so the display can be kept up to date	**3**	max 3. The explanation must match the sensor named. Accept light (sensor) with the reason that the car blocks / shades the light reaching it. Do not accept motion sensor (a parked car does not move). Do not credit pressure (the wheels do not touch the sensor). Do not credit level, flow, gas, humidity or moisture.

QUESTION	ANSWER	MARKS	GUIDANCE
6 0478 3.2.3(b)	Any four from: A humidity sensor measures (the amount of) water vapour / moisture in the air A moisture sensor measures the water content of the soil // how wet / dry the soil is The system needs to know whether the soil is dry // the plants take water from the soil (through their roots) The humidity of the air does not (reliably) show how wet the soil is // the air can be humid while the soil is dry (or the air dry while the soil is wet) ... so a humidity sensor could cause beds to be watered when they do not need it // not watered when they do A moisture sensor can be placed in (each) bed // in the soil near the roots, so it measures that bed directly	4	max 4. Max 2 if only one of the two sensors is described. Do not accept "a moisture sensor is more accurate" alone. Do not credit "a humidity sensor measures the water in the soil".

Total: 22 marks