

9	1 mark per bullet point, max 3 marks - Monitoring systems do not take any action whereas control systems act autonomously to change the environment if the values are out of a prescribed range - Control systems use actuators monitoring systems do not have any actuators - Control systems make use of feedback monitoring systems do not make use of feedback - The output from a monitoring system does not affect the subsequent input whereas output from a control system affects the next input.
10(a)	1 mark per bullet point, max 3 marks Generic mark points: (max 3) - Additive manufacturing - Uses a digital file created from 3D modelling software or Computer Aided Design (CAD) software - The printer builds up the model one layer at a time - The process is repeated for each layer - Some materials may need time to cool and set or UV curing using LEDs for photopolymer resins Specific mark points: (max 1) e.g. - Fused Deposition Modelling (FDM) // Material is heated and pushed through nozzle / extruder - Stereolithography (SLA) // Photosensitive liquid resin is exposed to a UV-laser beam - Digital Light Processing (DLP) // Photosensitive liquid resin is exposed to a UV projected image of the layer to cure the resin - Selective Laser Sintering (SLS) // Uses a laser to form objects from powdered material, the material can be plastics or metals
10(b)	1 mark - To free up the processor to carry out other tasks as the rate data is received by the printer is different from the rate at which it can be processed - To manage the mismatch in speed between the processor and the peripheral / 3D printer

11	1 mark per bullet point, max 3 marks Identification: Control system (no mark) Justification: - The system uses an actuator to open or close the doors - The output / opening the doors allows people to move, which changes the input to the sensor - The system acts autonomously on the feedback from a sensor
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4(a)	1 mark each to max 4 e.g. - Uses image recognition / facial recognition - Measures the distance between facial features of the customer - and stores the values in a database of user information - An image is captured using the digital camera - the AI identifies that the image is a face - by analysing the pixels to find patterns - the distance between features is calculated and compared to those in database						
4(b)	1 mark for sensor, 1 mark for corresponding use e.g. <table border="1"> <thead> <tr> <th>Sensor</th><th>Use</th></tr> </thead> <tbody> <tr> <td>Pressure</td><td>Detects when the pressure of an item is removed from a shelf / put back on a shelf</td></tr> <tr> <td>Infrared</td><td>Detects when the beam is broken for an item removed / added</td></tr> </tbody> </table>	Sensor	Use	Pressure	Detects when the pressure of an item is removed from a shelf / put back on a shelf	Infrared	Detects when the beam is broken for an item removed / added
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6(a)(i)	1 mark for each correctly completed space • platters • spindle • read/write head • magnetic field The magnetic hard disk has one or more platters that can be magnetised. These are mounted on a spindle and rotate at high speed. A read/write head is moved across the surface on an arm. When data is read the changes in the magnetic field produce a change in the electric current.
6(a)(ii)	1 mark each to max 3 • More RAM means more currently running data and instructions can be stored • without needing to use virtual memory • without having to fetch the data from secondary storage first • which has a slower access time • Less latency / delay waiting for instructions / data
6(a)(iii)	1 mark each to max 2 e.g. • Wider data bus means more data can be transferred between components at a time • there is less delay / latency when fetching data for a running process • Wider address bus means larger memory addresses can be used • allowing more memory locations to be accessed directly • so less likely to run out of memory
6(b)	1 mark each to max 5 e.g. • To provide a user interface • so that the user is able to communicate with the hardware • To manage memory • so that data can be stored and accessed • and multitasking is possible • To manage files • allowing the user to create, edit, update and delete files and folders • To manage inputs and outputs from hardware/peripherals • To handle processes • to make sure each process has fair access

2(a)	1 mark for each bullet point (max 3) e.g. • It is difficult to change / update the firmware by the user • Errors cannot be fixed easily // Troubleshooting / fault-finding / repairing is a specialist task / expensive • Functionality cannot be changed/extended easily // Cannot be easily adapted for another task • Faulty / outdated devices are often thrown away rather than repaired • ... leading to e-waste
2(b)	1 mark from: • DRAM is less expensive to manufacture/purchase than SRAM in the embedded system • DRAM has a higher bit density per chip // more data can be stored per chip
2(c)	1 mark for each bullet point (max 2) • EPROM uses ultraviolet light to erase data whilst EEPROM uses an electrical signal to do this • EPROM has to be removed from the circuit board when changing the data whilst EEPROM remains in the circuit when the data is changed • EPROM erases all the data, EEPROM can erase parts of the data
9(a)	1 mark for sensor and its use in this system • Infra-red sensor • Measure / check the height of the vehicle • Pressure sensor • Measure / check the weight of the vehicle
9(b)	1 mark for each bullet point (max 2) for a correct justification No marks for the identification of the system Monitoring system • Because there is no use of feedback // the warning sign is only an indicator • ... the output of the turning on of the sign does not affect the input of data from the sensors • The system does not have any actuators

2(a)	1 mark for each difference e.g. • DRAM requires constant refreshing, but SRAM does not need to be constantly refreshed • DRAM generally has greater capacities per chip, but SRAM generally has lower capacities per chip • DRAM has slower access times than SRAM
2(b)	1 mark for each bullet point (max 4) • The computer and the hard disk drive transmit and receive at different speeds // The computer transfers data faster than the HDD can receive • The buffer is used for temporary storage • ... so that the computer can transfer data to the buffer at the higher speed • ... and is not held up waiting for data to transfer • ... and so that data is transferred to hard disk drive from the buffer at the slower rate
3	1 mark for each bullet point (max 3) • The system uses feedback • The system acts independently • Input data causes the car to brake • ... braking decreases the/changes the distance to the object • ... this new distance is used to determine whether/how hard the car needs to brake

2(a)	1 mark each to max 2: • The doorbell only performs the specific tasks of motion detection/video recording/doorbell ringing • The motion sensor and digital camera are built into the doorbell • The CPU/memory/storage/software are all dedicated to this task only • Only a dedicated microprocessor is required due to the limited processing requirements
2(b)	No mark for identification of monitoring or control 1 mark each to max 2 for justification: Monitoring: • The turning on of the digital camera does not affect the input to the sensor/button • The transmission of the data/video does not affect the input to the sensor/button • The ringing of the doorbell does not affect the input to the button Control: • Video doorbell does not only store the values from the motion sensor • The data is processed, generating a signal to start the digital camera recording • Button pressed/motion detected causes a signal to be sent over a network to the smartphone
2(c)(i)	1 mark each to max 2: • Current reading/data from motion sensor • Current/recent video • Instructions being executed • Start-up/BIOS/boot-up instructions

2(c)(ii)	1 mark for each row: <table border="1"> <thead> <tr> <th data-bbox="284 156 840 193">Statement</th><th data-bbox="840 156 981 193">Answer</th></tr> </thead> <tbody> <tr> <td data-bbox="284 193 840 268">The two types of logic gate that can be used to create solid state devices</td><td data-bbox="840 193 981 268">NAND NOR</td></tr> <tr> <td data-bbox="284 268 840 304">The number of transistors contained in each cell</td><td data-bbox="840 268 981 304">1 or 2</td></tr> <tr> <td data-bbox="284 304 840 357">The type of gate that can retain electrons without power</td><td data-bbox="840 304 981 357">floating</td></tr> <tr> <td data-bbox="284 357 840 427">The type of gate that allows or stops current from passing through</td><td data-bbox="840 357 981 427">control</td></tr> </tbody> </table>	Statement	Answer	The two types of logic gate that can be used to create solid state devices	NAND NOR	The number of transistors contained in each cell	1 or 2	The type of gate that can retain electrons without power	floating	The type of gate that allows or stops current from passing through	control
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2(c)(iii)	1 mark each to max 2: • Captured video is transmitted to buffer • ... video is transmitted from buffer to smartphone • Store recent data in a buffer for the user to rewind • ... instead of storing everything in secondary storage • Store readings from motion sensor • ... until the microprocessor can process them • Store video from digital camera • ... before moving it to secondary storage										
2(d)	1 mark each to max 3: • Data transmission to user's smartphone will take longer • ... because there is more data to transmit • The secondary storage device will fill faster • ... fewer videos will be able to be stored long-term // videos are overwritten more often										
2(e)(i)	1 mark for: Continuous ordered flow of bits over a communication path										
2(e)(ii)	1 mark each to max 2: • Real-time is direct from source whereas on-demand is pre-recorded/downloaded to view later • Real-time cannot be re-watched, on-demand can be paused, re-watched etc. • Real-time plays continually, on-demand downloads sections/blocks and cannot play until next section is downloaded										