1	1	**Marks are for AO1 (understanding)** Magnetic disk drives are useful where large capacity is needed (without the cost of very large SSDs); Solid state disk drives have faster access speeds/lower latency than magnetic disk drives (which is useful for loading frequently used software) // access to data would be faster than if just magnetic disk drive was used; **R.** Faster by itself **Max** 1 if just differences are given rather than benefits of having both.	2
1	2	**Marks are for AO1 (understanding)** No movable parts (so no need for the read/write heads to move to the correct position); Purely electronic (so minimal latency);	2

2	1	**2 marks are for AO1 (understanding) and 2 marks are for AO2 (analyse)** **Mark as follows:** • SSDs have lower power drain; which is important as the life blogger will run on battery; • SSDs are less likely to be damaged if dropped; which is important as the devices will be worn and carried around; • SSDs have faster access time; which could allow more data to be stored per second (which may allow finer detail); • SSDs are silent; which means they will not disturb the users; • SSDs are lighter/less obtrusive/smaller; which is important for a device worn around the neck; • SSDs produce less heat; which makes them more comfortable to wear; **Max 2** for advantages **Max 2** for expansions **Max 4 marks**	4

Qu	Pt	Marking Guidance	Marks
3		**Marks are for AO2 (Analyse)** RFID tags are small/lightweight, making them easy to carry/integrate with Staff ID cards; RFID tags are cheap, making it more affordable to provide them to as many staff members as necessary; RFID tags are durable, making them more reliable over time / in emergency situations; RFID tags do not require their own power sources, making them more reliable / lower maintenance; RFID tags can be read quickly, making it suitable for access in emergency situations; RFID tag has storage, which could be used to store access credentials // no need to remember a keypad code // different staff could be given different access levels; RFID permits contactless access, allowing access where staff do not wish to touch a communal access control mechanism; **MAX 3** If no other marks awarded allow 1 mark for at least 2 reasons why RFID is used in this scenario, or at least 2 characteristics of RFID (with no reference to the scenario).	3

Qu	Pt	Marking Guidance	Marks
4	1	**Marks are for AO1 (understanding)** The RFID reader emits radio waves; (The antenna in the RFID tag allows) the radio waves to induce sufficient power in the tag to enable/power the tag // triggers an active tag; Data is stored on the chip/memory of the tag; In response the tag emits radio waves to transmit the data on the tag to the RFID reader; **A.** Frequency or signal for radio waves **Note:** Accept references to data, instead of radio waves, if it is made clear somewhere in the response that radio waves/signals/frequencies are being used. **Max 3**	3

Qu	Pt	Marking Guidance	Marks
4	2	**Marks are for AO1 (understanding)** Passive tags are smaller // are more convenient for users to carry; (As passive tags can only be read when close to the reader) it is less of a security risk // it is more difficult to intercept/steal the data from the passport; Using passive tags is likely to be cheaper than using active tags (especially at a national scale); In passive tags there is no need to replace/charge battery // in active tags battery may not last as long as the passport is valid; Accept points made as disadvantages of active tags or as advantages of passive tags **Max 2**	2

<table>
<tr><th>Qu</th><th>Pt</th><th>Marking Guidance</th><th>Marks</th></tr>
<tr><td>5</td><td></td><td>

6 marks are for AO1 (understanding)
6 marks are for AO2 (analyse)

Level of response question:

<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>3</td><td>A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. Answers in this level will demonstrate a clear and detailed awareness of the properties of solid-state drives. The response covers a wide range of issues and is likely to cover the moral ethical, legal and cultural aspects of the question. Several of the points made will have been expanded upon using clear examples and references to real-world implications.</td><td>9–12</td></tr>
<tr><td>2</td><td>A line of reasoning has been followed to produce a mostly coherent, relevant, substantiated and logically structured response. Answers in this level will identify a small number of properties of solid-state drives but may fail to develop points. The response is likely to cover at least two of moral, ethical, legal and cultural aspects of the question. Some of the points made may have been expanded on.</td><td>5–8</td></tr>
<tr><td>1</td><td>There is little evidence that a line of reasoning has been followed. Answers in this level may identify some properties of solid-state drives. Answers may have attempted to identify some moral, ethical, legal and cultural issues. Points are not likely to be expanded upon but where they are, the examples may not be relevant or not relate to the points being made.</td><td>1–4</td></tr>
</table>

Indicative content

<u>Area 1:</u> Moral, ethical, legal and cultural issues

Moral (individual beliefs)
- There is the potential for the technology to be misused by criminals (eg stalking, tracking partners/children/pets/strangers/property without permission).
- Criminals could put them into the pockets/luggage of targets/victims/children to find out where they live.
- Individuals might become over-reliant on the technology and not look after their property.
- Individuals might not wish for their phones to be used to send signals on behalf of other users or in support of the company's network, even with encryption.

Ethical (society)
- Right to privacy eroded as your movements are tracked by the company.
- "Big Brother" society where your every move is monitored and analysed.
- Could it be used to track people in a good way, for example elderly or ill patients.

</td><td>12</td></tr>
</table>

		• Individuals in some jurisdictions will have had to agree for their phones to relay signals in support of the company's network but they may not want to or even know that they have agreed to such terms. **Legal** • As the tag moves internationally through different countries different laws will exist about data collection and privacy. • Computer Misuse Act would be applied in the UK to prevent unauthorised access to the tag and the location data. • General Data Protection Regulation (GDPR) affords protections to data subjects and provides rights relating to access, accuracy, deletion, etc. **Cultural (subgroups)** • Older people might be very distrustful or fearful of this technology. • This tag would only work in an area with a high number of phones / phone coverage, therefore it is not suitable for rural locations or places with few phone users for other reasons. • Different societies may have different views on the privacy issues related to location tracking. **<u>Area 2</u>: Suitability of storage device** **Solid-state drive properties:** • Higher read and write speeds than hard disks (because there are no moving parts means they'd be more likely to keep up with the requests). • Less prone to (terminal) failure from dropping/collisions/movement (because there are no moving parts or joints), which means there is less likelihood of costs being incurred from damaged drives. • Generally more energy efficient, which can lead to reduced costs (operational and/or cooling), provide a cooler / more comfortable operating environment, and be more environmentally friendly. • Generally small in physical size, which means that the amount of space required to house them / operational cost can be reduced. • More expensive (per bit) for the same amount of memory, (which means that the company would be investing more in the purchase of the drives initially). • The lifetime of a solid-state drive is relatively fixed, due to there being an approximate maximum number of writes before it becomes unreliable/unusable.	

6	**1**	**1 mark for AO2 (analyse) and 1 mark for AO1 (understanding)** **AO2 (analyse) 1 mark:** A lot of individual products will need to be scanned simultaneously / when a lorry/delivery arrives/leaves; **AO1 (understanding) maximum 1 mark from this list:** • the RFID tags could be read without removing products from their pallet; • RFID tags can be read from a (greater) distance (than barcodes); • no need for a person to scan tags // no need to manually scan tags; • RFID tags can be read at a faster rate; • RFID tags less easily damaged (than barcodes) // barcodes can become easily damaged and made unreadable; • don't have to spend time locating barcodes on items; **R.** RFID tags can store more data (not relevant)	**2**

6	**2**	**1 mark for AO2 (analyse) and 1 mark for AO1 (understanding)** **AO1 (understanding) 1 mark:** Barcodes are cheaper than RFID tags // less electronic waste (assuming tags not reused) // barcodes can only be read when scanner pointed directly at them // barcodes not susceptible to radio interference // barcodes usually include human-readable encoding of same data; **AO2 (analyse) 1 mark:** Higher cost of RFID tags would be added on to prices // higher cost would have to be paid by manufacturer/supermarket/customer // barcodes can be scanned by existing equipment at checkouts // less risk of nearby product being accidentally scanned // backup system exists as barcodes can be keyed in;	**2**

6	**3**	**3 marks for AO1 (knowledge) – 3 marks:** • RFID reader/scanner (at warehouse entrance) transmits/sends signal; • Signal activates/energises/induces current in RFID transponder/tag; • RFID transponder/tag transmits/sends data by radio(wave); **3 marks for AO2 (analyse) – Max 3 marks:** • RFID signals processed into a format suitable for querying the database; • (SELECT) query used to check if there is already a record for the product/ProductID in the database // return of empty data set could be used to identify if the product is not in the table; **NE.** used to lookup record • UPDATE statement used to increase the QuantityInStock/stock level (by the number of items delivered) <u>if the product is already in the database</u>; • INSERT statement used to create new record for product <u>if it is not already in the database</u>; user will need to enter some details manually as these are not contained in the RFID tag.	**6**

Qu	Pt	Marking guidance	Total marks
07	1	**All marks AO1 (understanding)** **Why laser is suitable (Max 2):** Low cost per printed page // toner is cheaper (per page) than ink; Prints many pages per minute // high speed; Options to install a (greater) variety of paper trays // (greater) variety of paper handling options; Toner will not dry out; **A.** toner does not expire as quickly as ink; High resolution output; **Why having a wireless adapter is suitable (Max 2):** Easy to share printer between many devices; Can connect / print directly from computers / laptops with WiFi // no need to install a network / cabling / wireless router to facilitate wireless / network / remote printing; Printer can be managed remotely; WiFi should be fast enough for likely number of users / documents (as small office); WiFi should have sufficient range for devices to connect (as small office);	**3**

<table>
<tr><th>Qu</th><th>Pt</th><th>Marking guidance</th><th>Total marks</th></tr>
<tr><td>07</td><td>2</td><td>
All marks AO1 (understanding)
<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>3</td><td>A comprehensive description of how a laser printer works, which shows an excellent level of understanding, covering almost all of the indicative content below.</td><td>5–6</td></tr>
<tr><td>2</td><td>A sound description of how a laser printer works, which shows a good level of understanding. The key parts of the indicative content are covered but there are gaps in the description.</td><td>3–4</td></tr>
<tr><td>1</td><td>Some relevant points are made, but overall the description conveys only a limited understanding, either because only a very small number of points are made or the points made are not drawn together to form an accurate description.</td><td>1–2</td></tr>
</table>
<u>Guidance – Indicative Content</u>

Bitmap of image built in memory from page description.
(Negative) charge applied to (photosensitive) drum.
Laser beam directed at drum.
R. laser directed at paper.
Mirror is used to direct laser beam.
Where laser strikes drum charge is neutralised / reversed / cancelled / discharged.
(Negative) charge applied to toner.
Toner sticks to drum based on charge // where the laser struck.
Paper passed over drum and toner transfers to it.
Positively charged transfer roller assists transfer of toner from drum to paper.
A. charge applied to paper assists with transfer.
Heater fuses toner onto paper.
For colour printing four different colour toners // four drums are required.

</td><td>6</td></tr>
</table>

Question			Marks
8		**All marks AO1 (understanding)** **12**	

Level	Description	Mark Range
4	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers all three areas indicated in the guidance below and there is sufficient detail to show that the student has a good level of understanding of at least two of these.	10–12
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response which shows a good level of understanding of at least one area indicated in the guidance below and a satisfactory understanding of at least one other area.	7–9
2	A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. Either a good level of understanding has been demonstrated of one area or some understanding had been demonstrated of at least two areas.	4–6
1	A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points may only relate to one or two of the areas from the guidance. There is insufficient evidence of a good understanding of any of the three areas.	1–3

Guidance – Indicative Content

Area 1: How RFID works

RFID tag contains (transmission) circuitry and antenna
Memory on tag stores (customer) data
RFID reader (at till) transmits / sends signal // emits electric / electro-magnetic field
Signal activates / energises / induces current in RFID tag
RFID tag transmits / sends data by radio (wave)
RFID reader converts radio (wave) / signal back into (binary) data
RFID tag (on a card) is a passive device
RFID transmits over very short range

Area 2: How barcode works

(reflected light method)
A light source / laser is directed at bar code // bar code is illuminated
(Moving) mirror / prism moves light beam across bar code // user moves reader across bar code // user moves the bar code across the reader
Light reflected back
Black / white bands reflect different amounts of light // black reflects less light // white reflects more light
Light sensor / photodiode / CCD (measures amount of reflected light)

		Light reflected converted into an electrical signal **A.** convert reflection to (binary) numbers / characters / ASCII
		
		(CMOS/CCD/camera method)
		Grid of (pixel) sensors // CMOS/CCD sensor
		Each sensor measures light intensity of a point
		Sensor outputs a voltage dependent upon light intensity
		Voltages turned into binary data // voltages passed through Analogue-to-Digital Converter (ADC) // voltages turned into a digitised version of the image / barcode
		Image processing software analyses image
		This identifies black / white bands in barcode (which are turned into numbers)
		
		Note: Students only need to describe one of the two methods for barcodes.
		
		Area 3: Ethical and legal issues
		
		(ethical)
		Customers may believe that data about what they buy/spend is personal // invasion of privacy
		Purchase of some items might be considered sensitive // some data might be considered to be sensitive (accept relevant examples)
		Will people fully understand what will be done with the data, even if they are told it is being collected
		Customers need to decide whether to allow the store to collect data about them (is it worth it for the return that they may get eg incentives / vouchers?) //do people feel forced to consent to benefit from offers
		Can company be sufficiently confident that any other companies they share the data with will process the data legally / fairly/for the purposes that they said they would?
		Risk of the supermarket carrying out actions that might reveal to other members of a shopper's household things that the supermarket has deduced that the householders don't know
		Should ethical consideration be given to the products promoted to people using the data collected about them or is it okay to promote a product to anyone?
		Are there some types of customers who should not be targeted with promotions at all // is it ethical to promote products to vulnerable customers?
		
		(legal)
		Naming a relevant law – GDPR, Data Protection Act
		Need to inform customers of what will be done with data // consent required to collect data **R.** customer has not consented
		Data must be kept securely
		Need to consider what purposes data should be used for
		Consideration of who should be able to access the data // there are rules about who the data can be shared with
		Possible negative impact if data stolen or leaked // information could be misused
		Limit on time-period that the data can be kept for
		Need to ensure that collected data is accurate
		Ensure data only transferred to countries it is legally allowed to go to // if transferred abroad, different laws may apply
		The supermarket should let the customers see/edit data about them
		Use of RFID might make data vulnerable to theft	

Question			Marks
9	1	**All marks AO1 (understanding)** To store data / programs whilst the computer is turned off; **A.** long-term / permanent storage **NE.** secondary storage devices are non-volatile **NE**. store data this is not in use (As) the contents of RAM are lost when the computer is turned off; **R.** "main memory" for "RAM" **A.** main memory (RAM) To transfer data / programs between computers; **NE.** secondary storage devices are portable Allows the storage of data sets / files that could not fit in RAM // computer architecture supports a limited amount of main memory/RAM; **A.** primary store for main memory **NE.** to extend storage capacity, to store more, to store large files, higher capacity **Max 2**	**2**

<table>
<tr><th colspan="2">Question</th><th></th><th>Marks</th></tr>
<tr><td>9</td><td>2</td><td>
All marks AO1 (understanding)
<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>2</td><td>A good understanding of the operation of an SSD has been demonstrated. The response is well structured, covers most of the points in the indicative content and does not contain any errors of understanding.</td><td>3-4</td></tr>
<tr><td>1</td><td>Some relevant points have been made, but the description omits important details or contains some errors so that only a limited understanding is demonstrated.</td><td>1-2</td></tr>
</table>
Indicative content:

Data is stored electronically // there are no mechanical / moving parts
Data is stored in floating gate transistors // data is stored in transistors that do not lose their charge/state <u>when power is no longer applied</u> // electrons are trapped between oxide layers
Presence of trapped electrons / charge or absence indicates 0 / 1
A. 0 or 1 either way around
A. state represents 0 or 1
A. off = 0, on = 1 (or other way around)
A. “bit” for 0 or 1, but not “binary”
R. positive and negative charges
NAND memory // flash memory // EEPROM memory is used
Data is organised into pages / blocks
A whole block (A. page) of data must be written // it is not possible to write individual values
A block (A. page) must be erased before it can be overwritten
Controller manages the organisation of the data // controller manages the reading and writing of data

</td><td>4</td></tr>
</table>

<table>
<tr><th>Qu</th><th>Pt</th><th>Marking guidance</th><th>Total marks</th></tr>
<tr><td>10</td><td>1</td><td>

All marks AO1 (understanding)

<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>4</td><td>A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically-structured response. The response covers both areas indicated in the guidance below and, in each area, there is sufficient detail to show that the student has a good level of understanding.</td><td>10–12</td></tr>
<tr><td>3</td><td>A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response which shows a good level of understanding of at least one area indicated in the guidance below and some understanding of the other area or a reasonable understanding of both areas.</td><td>7–9</td></tr>
<tr><td>2</td><td>A limited attempt has been made to follow a line of reasoning and the response has a mostly logical structure. A reasonable level of understanding has been shown of one area or some understanding of both areas.</td><td>4–6</td></tr>
<tr><td>1</td><td>A few relevant points have been made but there is no evidence that a line of reasoning has been followed.</td><td>1–3</td></tr>
</table>

<u>Guidance – Indicative Content</u>

Area 1: How data is stored on and read from a magnetic hard disk drive

<table>
<tr><th>Key Points</th><th>Additional Points</th></tr>
<tr><td>Disk is coated in a magnetisable material // iron / cobalt-based material

Magnetising a spot in one direction could represent 0 and the other direction could represent 1 A. any plausible way of representing two values

Disk divided into rings called tracks

Tracks divided into sectors / blocks

Read/write head moves in / out (radially) (to correct track)

Wait until correct sector / block passes under read/write head

Disk spins at high speed

Read/write head senses magnetic field and converts to 0s and 1s</td><td>Whole block read together

Data stored in buffer while being read

Can be many disks inside drive known as platters

Disk and drive are a sealed unit

Data near outside edge of disk stored less densely // disk has constant angular velocity

Files stored in hierarchical structure / directories

Free / used space indicated in file allocation table

Mirroring / striping / RAID may be used for automatic backup // to protect against drive failure</td></tr>
</table>

</td><td>12</td></tr>
</table>

A good understanding could be demonstrated by covering many of the points in the 'Key Points' column of the table, conveying the fundamental method by which magnetic hard disks work, but may omit some detail. Referencing points in the 'Additional Points' column could compensate for any omissions in the 'Key Points' column, but is not required.

Area 2: How the TCP/IP stack is used in the file server

- Four layers of stack are Application, Transport, Network/Internet and Link/Physical.
- File will be passed down/through each layer in turn.

Layer	Key Points	Additional Points
Application	File server software will operate in the Application Layer File transfer may use FTP protocol	Alternative protocols are SMB, NFS
Transport	Establishes end-to-end connection between file server and computer Receives file / data on a port from the application layer // adds source and destination port numbers to segment Splits file / data into segments Adds checksum to segment // adds error detection information to segment // deals with transmission errors // retransmits lost / corrupted segments **A.** packet for segment	Performs flow control Performs congestion control Adds sequence number to segment May use TCP or UDP protocol
Network / Internet	Adds source and destination IP addresses to datagram **R.** routes data across network **A.** packet for datagram	Encapsulates each TCP/IP segment into an IP datagram Add time to live Uses subnet mask to determine if destination is on same subnet
Link / Physical	Physical interface to network communications medium // writes (encoding of) data to communications medium (**A.** cable for medium) Uses device drivers // uses network interface card Adds hardware / MAC address of destination / router / gateway / source	

Points cannot be credited unless they are linked to the appropriate layer.

		A good understanding could be demonstrated by covering many of the points in the 'Key Points' column of the table, including naming all four layers and making a range of accurate points about at least three of them. Referencing points in the 'Additional Points' column could compensate for any omissions in the 'Key Points' column, but is not required.	

Qu	Pt	Marking guidance	Total marks
10	**2**	**All marks AO1 (understanding)** **Advantage (1 mark):** • lower power consumption • faster access times // faster transfer rate // lower latency **NE.** faster • smaller (physically) • generate less heat // require less cooling • lower failure rate // less susceptible to damage from impact // not affected by magnetic fields **A.** more reliable **R.** quieter **R.** portable **Disadvantage (1 mark):** • higher cost (per megabyte) • higher error rate (over time) // more blocks become unusable over time in an SSD **R.** lower capacity	**2**