<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>a</td><td></td><td>1 mark each

<table><tr><th>8-bit Binary</th><th>Denary</th></tr><tr><td>11110000</td><td>240</td></tr><tr><td>01101001</td><td>105</td></tr><tr><td>00011110</td><td>30</td></tr></table></td><td>3</td><td>Binary must be 8-bits

<u>Examiner’s Comments</u>

Candidates were often able to correctly convert the numbers between the two forms. The conversion from binary to denary was most commonly accurate with more candidates inaccurately converting from denary to binary.</td></tr>
<tr><td></td><td>b</td><td></td><td>1 mark each

<table><tr><th>Statement</th><th>Answer</th></tr><tr><td>The smallest denary number that can be represented by a 4-bit binary number</td><td>0</td></tr><tr><td>The largest denary number that can be represented by a 6-bit binary number</td><td>63</td></tr><tr><td>The maximum number of different colours that can be represented with a colour depth of 7-bits</td><td>128</td></tr><tr><td>The minimum number of bits needed to represent 150 different characters in a character set</td><td>8</td></tr></table></td><td>4</td><td>Accept calculations that equate to the same answer.

Accept any number of 0s for the first answer.

<u>Examiner’s Comments</u>

This question required candidates to consider the storage of denary numbers in binary in ways other than converting them. Candidates commonly gave the correct smallest denary number, although a common error was giving 1 instead of 0. Some candidates used 7-bit or 8-bit binary numbers for the second response or gave the next value of 64. Candidates found the third response more challenging with many giving 256 for an 8-bit binary number or giving the largest value of 127. The final response had the greatest variance of answers ranging from 1, 2 up to 16 or even 32.</td></tr>
<tr><td></td><td>c</td><td></td><td>11110000</td><td>1</td><td>Ignore leading 0s

<u>Examiner’s Comments</u>

Candidates often gave the correct response by shifting the digits accurately. Some candidates did not shift the correct number of places, for example moving 3 places.</td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
	d		1 mark for an example 2-digit hex number **correctly** converted into denary. 1 mark each to max 2 for describing/showing each stage. Either: Multiplying: • **Multiply the left/first digit by 16** • **Add** value of **second** digit (without additional calculation) Or: Converting: • Convert each digit into **4-bit binary** • Combine and convert the **8-bit binary** to denary	3	No marks for converting denary to hex. If the example has an inaccurate result, for example they have converted A to 11. They can still get the method marks. No requirement to show how letters are used. Examiner's Comments Candidates that did well on this question used the example to show how they converted a value from hexadecimal to denary. They included annotations to show what they were doing at each stage. Candidates often chose a hexadecimal value that included a letter. Some candidates chose hexadecimal values that were straightforward to convert, for example A0 where they multiplied 16 by 10 and then added 0. Some candidates chose a more complicated calculation and did not always calculate the correct result.
	e		1 mark for correct working (4 carries) 1 mark for answer 01111010 Working showing carries e.g. 01101011 00001111 01111010 1111	2	Do not award working mark for conversion to denary and back. Carries must be on the correct values, but could be above, below etc. Examiner's Comments Most candidates attempted to show their working, commonly by including the carries in an appropriate place. Where the working was correct the answer was also often accurate. Some candidates converted the binary numbers to denary, added them and then converted the result back into denary. This method allowed them to get the answer but did not gain the working marks.
			Total	13	

Question			Answer/Indicative content	Marks	Guidance
2	a	i	1 mark for each valid IP v4: • 4 groups of denary numbers between 0 and 255 separated by full stops (example v4: 123.16.46.72) v6 • 8 groups of hex numbers between 0 and FFFF separated by colons. Double colon can appear **once** and replaces any number of groups of consecutive 0000 (example v6: 0252:5985:89ab:cdde:a57f:89ad:efcd:00fe) (example v6: F513:8C:2A::999:0000 expanded would be F513:8C:2A:0000:0000:0000:999:0000)	2	V6 Each hex number can be between 1 and 4 digits Examiner's Comments Many candidates found this question challenging with few candidates giving valid IP addresses. IPv4 was more commonly accurate, although a common error was giving numbers greater than 255. Few candidates were able to give an IPv6 address. Common errors including giving 6 groups of numbers and separating each group with a full stop.
		ii	1 mark each to max 2 • (usually presented in) hexadecimal / denary / binary • 6 groups of numbers // 12 (hex) numbers • … each group has paired/2-digit (hex) numbers / 8 bit binary number • 48 bits long • Separated by colons/hyphens • (The first half/part) contains the **manufacturer ID** // (first half/part) identifies the manufacturer • (The second half/part) contains the **serial number** // (second half/part) identifies the device	2	MP1 'numbers' is NE Allow both marks for a valid example. NB '6 pairs of numbers' gets MP2 and MP3. '4 pairs of numbers' gets MP3 Examiner's Comments The most common responses given marks included identifying that it is usually in hexadecimal and that the groups are separated by colons or hyphens. Some candidates identified the two separate parts of the MAC address.

Question			Answer/Indicative content	Marks	Guidance
	b	i	1 mark each for benefit 1 for application to max 4 e.g. • Fast connection/speed // high bandwidth // consistent bandwidth • … e.g. reduce delays at check in // by example for airport • Secure // unlikely to have unauthorised access/hacked // data transmissions are likely to be safe • … e.g. so that data about passengers/staff/aeroplanes is not intercepted // by example for airport • Little interference // little chance of data loss // reliable • … e.g. flight status is received without delay // by example for airport • Long range transmission • … e.g. airport has a large floor area/terminals // by example for airport	4	Mark in pairs. Mark each benefit space to the candidates' benefit. An expansion/application for a benefit can be awarded in the other answer space. 1 benefit and 1 expansion for each answer space. Max 2 marks per answer space. **Max 3** marks if expansions have no direct application to the **airport** and its **computers** connecting using **wired** connections. If the second expansion is not applied, annotate with **^** NOT cost The question is not a comparison to wireless, but accept answers worded in this way. Fast on its own is NE. 'faster to connect' is NE because this couldbe to set up the connection as opposed to the bandwidth. <u>Examiner's Comments</u> Candidates were often able to identify benefits of wired connections but did not include application to the airport. For example, identifying that data was more secure but then repeating this same point by saying data is less likely to be intercepted. To gain the extra marks candidates needed to consider why each point was important in the airport, for example security is important due to the sensitive or private data that is being transmitted around the airport, or the high risk data that could potentially interfere with flights. The most common benefits included the faster transmission speed and the increased security.

Question			Answer/Indicative content	Marks	Guidance
		ii	1 mark each to max 3 e.g. • Staff do not need to be in one-place // movement of staff // can work whilst moving to another part of the airport // can be accessed from any location (in range) • Staff can be more responsive to customers/requests • Allows a larger number of connections/devices // more scalable … • … without the disruption/cost of installing more cables • Some devices do not allow physical/wired connection // allow wider range of type of device (or by example such as vehicles/mobile devices/aeroplanes) • Easier to add/connect more devices • Do not need to find/use a physical connection/wire // can allow you to connect in a place where there isn't a cable/connection • For use as a backup if the wired connection fails	3	Do not award cost on its own. Do not award range on its own. Allow explanation of how a wireless network will benefit the passenger as well as the airport and staff. Allow in reverse if clear, for example wired restricts staff to one location. <u>Examiner's Comments</u> In this question candidates needed to consider why wireless connections should also be allowed. Some candidates inaccurately took this as instead of wired and explained why this should be used instead, for example because they won't need any cables in the airport. A common response was that wireless was cheaper than wired, when there was already a wired connection so adding a wireless connection as well would be an extra cost instead of saving money. Common responses included the ability to move around and stay connected, as well as the larger number of devices that could connect. Some candidates identified that devices may not have ports that allow for a physical wired connection. The stronger responses included direct application to the airport, for example identifying the need for staff to respond to problems whilst in different areas of the airport such as tracking luggage or communicating problems.

Question			Answer/Indicative content	Marks	Guidance
	c	i	1 mark each for drawing showing: • 5 computers, 2 printers and 1 switch **all clearly labelled** • All devices directly connected to the **switch** // all computers connected to **switch** and each printer to a switch/computer(s) • Only 8 devices **and** no additional connections other than to the switch (or central device, or printers to only one computer each)	3	Allow any type of computer e.g. PC, laptop. Do not accept client for computer. MP1 there must be at least 5 computers, at least 2 printers, at least 1 switch <u>Examiner's Comments</u> Many candidates were able to draw a diagram that included the five computers, the switch and the two printers. Some candidates did not label these items, instead drawing eight boxes without identify which device each one represented. Candidates often joined these devices to the switch, with printers occasionally being connected to other computers that were then connected to the switch. Some candidates did not identify the central device, or incorrectly included an extra central device such as a router or a server. Some candidates then included extra connections that created a mesh network instead of a star topology.
		ii	1 mark for benefit e.g. • Easier to add new nodes // easier to setup BOD • Central device can monitor/control **transmissions** • Faster data transmission • Fewer data collisions • One connection/computer breaks the network still works • Less cost of **cables** 1 mark for drawback e.g. • Switch fails the network fails // reliant on a central device (working) // single point of failure • Extra cost of **central device/switch**	2	Speed, cheaper etc. on its own is NE Server is irrelevant. Read whole benefit and award a valid benefit. Read whole drawback and award a valid drawback. Do not award contradictory statements. <u>Examiner's Comments</u> Candidates were often able to give an appropriate benefit, most commonly that it was easier to add a new computer to the network. Candidates also commonly identified the drawback that the network is dependent on the central device.

Question			Answer/Indicative content	Marks	Guidance
		iii	1 mark each to max 3 e.g. • Connects the devices together in the network // allows devices to communicate in the network • **Receives** data from (all) devices in the star topology • Record/register/store the address of devices connected to it … • … in a table • Uses MAC address of devices • Direct data to **destination** • … if address not recorded transmit to all devices	3	<u>Examiner's Comments</u> Candidates commonly identified that the data from each computer in the network is sent directly to the switch, as well as this data then being sent to the destination. Some candidates confused a switch with a hub and identified that the data was sent to all devices connected to it. Some of the stronger responses identified how the switch records the MAC addresses of devices connected to it and used these to identify which device the data needed to the transmitted to. **Misconception** A common misconception was that a switch performed the same role as a server, with candidates incorrectly identifying that the switch stored the data for devices in the network and that the switch provided services to the connected devices.
			Total	**19**	

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<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>a</td><td></td><td>1 mark for function and 1 name for task

<table><tr><th>Function</th><th>Task</th></tr><tr><td>Memory management // managing memory</td><td>Moves data from secondary storage to RAM</td></tr><tr><td>Peripheral management</td><td>• Receiving data from input devices
• Transmitting data to output devices
• Installing/downloading device drivers
• Allows communication from input device / to output device</td></tr><tr><td>File management // managing files</td><td>Allows the user to create, name and delete folders</td></tr><tr><td>User interface</td><td>• Outputting data to the user
• Receiving input from the user
• Allows user to communicate / interact with / control the computer
• Creating / displaying / allowing interaction with a GUI / command prompt interface</td></tr></table></td><td>4</td><td>BOD storage for memory in the first function.

Peripheral: allow input and output devices by example.

File management, do not award folder management.

The task for peripheral management needs to extend 'manage' i.e. 'manage output devices' is NE.

<u>Examiner's Comments</u>

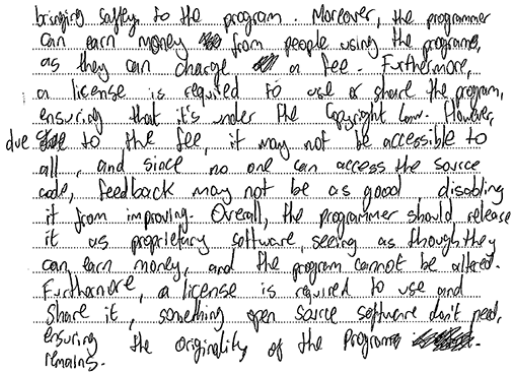
Candidates were often able to identify the function of memory management and file management for the given tasks.

Few candidates were able to identify a task performed by peripheral management. Candidates often rephrased 'peripheral management' for example stating that it managed the peripherals or managed the hardware without identifying what this involved. The stronger responses identified the role of device drivers to allow for communication between the computer and the peripherals.

Candidates often gave a suitable task for the user interface, most commonly that it allowed the user to communicate with the computer or hardware.</td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
	b		1 mark for each term **encryption** software changes data using a **key**. If the changed data is intercepted it cannot be **understood**. This software does not stop the data from being intercepted. **defragmentation** software analyses the data on a disk to find files that have been split and stored in separate locations. The split files are moved to be **consecutive** in storage and the free space is moved together. This does not provide more storage space on the disk, instead it makes the **access** of the data faster because the read head does not have to move as far to access the next part of the file.	6	Encryption Key Understood Defragmentation Consecutive Access Mark first answer in each space. Examiner's Comments Candidates were often able to accurately identify some of the missing words. The spaces for encryption were more often accurate, with a common error being the use of a lock to change the data instead of a key. Candidates often identified defragmentation accurately but the remaining spaces were more often inaccurate with access or separate often given in the next space.
			Total	10	

Question	Answer/Indicative content	Marks	Guidance
4	**Mark Band 3–High Level** **(6-8 marks)** The candidate demonstrates a thorough knowledge and understanding of a wide range of considerations in relation to the question; the material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation. The candidate is able to weigh up both sides of the discussion and includes reference to the impact on all areas showing thorough recognition of influencing factors. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* The answer covers all required elements (legal/ethical, benefits, drawbacks) given in the question about open source **and** proprietary and includes a recommendation with justification. The top of the band makes a clear and structured recommendation to the programmer. **Mark Band 2-Mid Level** **(3-5 marks)** The candidate demonstrates reasonable knowledge and understanding of a range of considerations in relation to the question; the material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation. **The candidate makes a reasonable attempt to discuss the impact on most areas, showing reasonable recognition of influencing factors.** *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* The answer includes one or more from legal/ethical, benefits, drawbacks for open source and proprietary. Alternatively, the answer could have a justified recommendation without clearly	8 AO2 1a (4) AO2 1b (4)	The following is indicative of possible factors/evidence that candidates may refer to but is not prescriptive or exhaustive: **Indicative Content:** Licence features Open source – (usually free), can access/change source code, redistribute Proprietary – purchase at a cost, cannot access/change code Legal and ethical issues: • Both provide copyright • Open source – allows more people to take code and possibly change to resell, or adapt in their own programs to resell or claim as their own (reverse for proprietary) • Open source – allows more people access to the game because there is likely no cost (reverse for proprietary) Benefits and drawbacks: • Open source – wider customer base, more exposure, users can alter to make it better/fix bugs, limited documentation, little financial gain • Proprietary – allows programmer to earn money, gives more control over what happens with the program, usually well tested, more restrictions for copyright, cannot be adapted to meet user needs, Decision: Either would be appropriate, justification needs to be clearly for the scenario <u>Examiner's Comments</u> This question required candidates to provide an extended response. An extended response can be given in the form or paragraphs, key points as well as a table of points. Candidates need to make sure they are covering the three bullet points in the question for both the open source licence and proprietary. The question also asked for a recommendation to the programmer.

Question	Answer/Indicative content	Marks	Guidance
	referencing the bullet points in the question. **Mark Band 1-Low Level** **(1-2 marks)** The candidate demonstrates a basic knowledge of considerations with limited understanding shown; the material is basic and contains some inaccuracies. Thecandidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides nothing more than an unsupported assertion. *The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.* The answer is limited to the facts about open source **and/or** proprietary. **0 mark** No attempt to answer the question or response is not worthy of credit		Candidates were often able to identify the features of each licence, for example if the source code was provided. Candidates often included benefits and drawbacks, for example being able to edit the program to tailor it to their needs, the potential of misuse of the program code. Candidates often covered legal and ethical issues within their benefits and drawbacks without explicitly identifying them. Fewer candidates included a recommendation for the programmer. Candidates described each in turn without identifying which one should be used. Some candidates suggested that both were suitable and it was the programmer's decision, but the question asked for a recommendation. The stronger responses discussed each licence in turn and then in the final paragraph started with a clear recommendation and justified the reasons for this by providing a summary of the points they had discussed in detail previously. **Exemplar 1**  bringing safety to the program. Moreover, the programmer can earn money from people using the programme, as they can charge a fee. Furthermore, a license is required to use or share the program, ensuring that it's under the Copyright law. However, due to the fee, it may not be accessible to all, and since no one can access the source code, feedback may not be as good, disabling it from improving. Overall, the programmer should release it as proprietary software, seeing as though they can earn money, and the program cannot be altered. Furthermore, a license is required to use and share it, something open source software don't need, ensuring the originality of the program remains. This response has a clear recommendation at the end of the response. They have stated that the programmer should use proprietary and provided a summary of the reasons (discussed previously) as to why they think this is the most appropriate recommendation.
	Total	**8**	

Question			Answer/Indicative content	Marks	Guidance
5	a	i	1 mark for The amplitude of the wave is measured at set intervals	1	2+ ticks = 0 marks Examiner's Comments Some candidates were able to correctly identify that it was the amplitude that is measured at set intervals. A common error was that the frequency of the wave is measured, the frequency is a technical sound term that relates to the pitch of the wave, or the number of times the wave changes.
		ii	1 mark each to max 2 • The number of bits per sample will change // by example e.g. there will be more/less bits per sample • The file size will change // by example e.g. the file size will increase/decrease • There will be a change in the accuracy of each sample/amplitude/sound // by example e.g. more precise amplitudes // by example e.g. a wider/smaller range of amplitudes can be recorded • The quality will change // there will a different amount of distortion // by example e.g. the quality will improve/decline	2	MP3 needs to be clearly a wider range of amplitudes can be recorded i.e. more different values. **Not** that there are more **amplitudes/samples per second**. MP3 – 'more amplitudes can be measured' is BOD, but 'more amplitudes measured per second' is incorrect. BOD 'sound' for 'amplitude' e.g. for MP3 "a larger range of sounds can be recorded." Examiner's Comments This question was answered well by many candidates who were most commonly able to identify that the file size would change. Many candidates gave this through an example that when the bit depth increases the file size also increases. Candidates also often identified that the quality of the sound would increase, or that the sound would become more accurate when compared to the sound being recorded. Some candidates incorrectly identified that the bit depth would result in more samples being taken per second.
	b	i	No mark for type. Accept the type by example e.g. HDD for magnetic. 1 mark each for each point matching to type given to max 4 Magnetic e.g. • (Usually) cheaper cost to purchase per unit of data • Sufficient/good durability for what is needed • … computer unlikely to move	4	MP1 needs to be cost per unit e.g. it costs less per GB than other storage types. Not just 'it is cheap to buy'. Allow reverse argument for each e.g. for magnetic, why they have not chosen solid state. For example: 'magnetic is not as robust but the computer will not be moved' gets 1 mark for the not moving, and 1 mark for solid state's robustness is not required.

Question	Answer/Indicative content	Marks	Guidance
	(regularly) // by example • Sufficient/fast speed of access • … no significant delays in storing/reading data • (Long-term) reliable // longevity • … unlikely to need to purchase another //unlikely to break from over-use • High capacity • … e.g. file size of sound files can be large // allows the musician to store files with higher bit depth Solid state e.g. • Cost often equates to magnetic per quantity // not expensive per unit of data • Durable // robust // no moving parts • … so computer can be moved without risk of losing data • Fast speed of access of data • … no significant delays in storing/reading data // musician does not have to wait for files to load/store • High capacity // (nearly the) same/higher capacity than magnetic • … file size of sound can be large • Small in physical size • … device is portable // can fit in a smaller type of computer • Produces less sound when running • … so the musician distracted • Requires little/less power (compared to others) • … so running costs are reduced • Drives do not get fragmented files • … drives do not need to be defragged // constant access time		If there is no type give on line 1. Read the answer to look for a type and then award justification. If there is not type identified anywhere in the answer, 0 marks. <u>Examiner's Comments</u> This question required candidates to identify which of the two choices they would make and to justify their choice. Either choice was appropriate and candidates were given marks for explaining why they had made the choice they did. There was no common choice with both often being selected. Choices were often suitably justified. Common points included the amount of data that could be stored with some candidates also linking this to the need for sound files to have a high capacity. Candidates often identified that solid state has a faster access speed than magnetic, although some responses just stated that it was faster without identifying what it was faster at. When justifying solid state candidates often identified the robustness of the device and linked this to the musician possibly needing to move the device. Magnetic justifications often identified that although they had slower access speed than solid state this would still be sufficient. They also identified that it does have moving parts, but if the device is not being moved then the durability of solid state is also not required.  **Misconception** A misconception is that solid state devices have more longevity than magnetic, that they have an unlimited life span and will outlast magnetic.

Question			Answer/Indicative content	Marks	Guidance
		ii	1 mark for Optical	1	BOD optic. Do not award an example of optical storage Examiner's Comments Some candidates found this question challenging and were not able to give a different type of secondary storage, often repeating magnetic or solid state from the question. Candidates quite often did not provide a response to this question.
		iii	1 mark for 200 000 KB	1	2+ ticks = 0 marks Examiner's Comments Some candidates were able to correctly identify the smallest capacity of 200 000KB. 300MB was often inaccurately selected.
		iv	1 mark for the answer 3 GB 1 for working e.g. • 3 * 1000 / 1000 • 3 * 1000 • 3000 / 1000 • 3 / 1000 • 0.003 * 1000	2	Allow 2.9296875 (or approximated) for division by 1024. Allow addition of metadata e.g. 10% added. This can be awarded for both working and answer. Not all of the working needs to be correct to get the working mark. Ignore mention of MB/GB in the working. Examiner's Comments Candidates were often able to gain a mark for partial working, for example by multiplying 3 and 1000 even if other parts of the working then performed incorrect calculations.
			Total	11	

Question			Answer/Indicative content	Marks	Guidance
6	a		1 mark each • **Data/instructions** are fetched from **memory/RAM/primary storage** • **Data/instruction**s are stored using the registers // **correct example** of a register storing address/data • **Data/instructions** are decoded // **Data/instructions** are split into opcode and operand • **Data/instructions** are **executed/processed** • **ALU** performs the logical/arithmetic calculations	2	MP4 BOD carried out etc. for executed. Ignore inaccurate references to registers and components (other than MP2 correct example of a register). <u>Examiner's Comments</u> Candidates often correctly identified that data is fetched from memory, or from RAM, and are then processed. Some candidates gave a more technical description including the role of the registers in this process. The stronger responses included clear references to data or instructions being processed. Some candidates inaccurately identified that information was processed, or that programs were fetched from memory.

Question			Answer/Indicative content	Marks	Guidance
	b		1 mark for naming register, 1 for matching purpose • Program counter // PC • **Stores** the **address** of the **current/next** instruction to be fetched // **stores** the **address** of the instruction for the **current/next** FE **cycle** • Memory address register // MAR • **Stores** the **address** of the **current/next** instruction/data to be fetched // **stores** the **address** where data/instruction is to be stored • Memory data register // MDR • **Stores** the **data/instruction** fetched from memory // **stores data/instruction** to be stored in memory // stores the **data/instruction** located in the **memory** location in the **MAR** • Accumulator // ACC • **Stores** the **result** of calculations // **stores data currently** being processed / by example // **stores** the result from the ALU	4	Careful that the purpose is not an action such as fetches, takes, retrieves. Read full purpose and award a correct point Accept • Current instruction register//CIR//Instruction register//IR • Stores the instruction currently being executed BOD memory buffer register for MDR. If there is no register but the register is given in the purpose column, award the purpose if accurate. If the answer in the register column is incorrect, do not mark purpose. For PC and MAR, accept 'pointer' for storing address Accept memory address, memory data Examiner's Comments Candidates were often able to identify one or two registers that are used in the F-E cycle. Fewer candidates were able to give a purpose in the F-E cycle. Some candidates identified that the registers were involved in the fetching or transmission of data, for example that the MAR transmits the address to RAM.. Misconception A common misconception is that the program counter keeps track of how many programs have run or counts the instructions that are being processed.

Question			Answer/Indicative content	Marks	Guidance
	c		1 mark each to max 3 • Clock speed • Cache size • Number of cores	3	'clock' 'cache' 'speed' 'cores' on its own is NE. Examiner's Comments Candidates were often able to identify at least one characteristic of a CPU, most commonly the clock speed and number of cores. Some responses were not precise enough as to the characteristics, for example stating 'clock' or 'core' without reference to the speed of the clock, or the number of cores, which were too ambiguous.
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
7	a		1 mark each to max 3 • Has a specific purpose // it only performs one/limited task // dedicated to the Follow Me system • Built within a larger device/car • Dedicated/specific/its own hardware / sensors • Has a microprocessor • Built-in operating system/software // software is all in firmware/ROM • … it's instructions/operation does not/is hard to change/update • It is a control system // it is automated	3	MP2 BOD reference to it being 'built into' 'something' reasonable Examiner's Comments This question required candidates to apply their understanding of embedded systems to a different system. Candidates were often able to identify the key features of embedded systems that were relevant to this scenario. The most common points being that the system has a single purpose. Some candidates also identified that the system is built within a larger system, being the car. Fewer candidates were able to provide a third point. Those that did most commonly identified the dedicated hardware or gave an example such as the sensors are only providing data for this system.
	b	i	1 mark each to max 2 • Start-up instructions // BIOS // bootstrap // where to find the OS • Firmware // Program/instruction to run the Follow Me system // Instructions for operation • Example of data being stored e.g. the maximum speed, the min distance • Operating System // OS	2	MP2 'programs' on its own is NE MP3, Allow two marks for examples of instructions or data. For example both marks can be given for: 1 – The maximum speed 'Follow Me' can operate 2 – The minimum distance the car in front can be Examiner's Comments Many candidates were able to identify that ROM stores the start-up instructions or gave an example of these instructions. Some candidates were also able to identify that an embedded system runs firmware, or gave a description of the program for this system being stored in the ROM.

Question			Answer/Indicative content	Marks	Guidance
		ii	1 mark each to max 3 e.g. • Current distance from car in front • Set distance from car in front • Current speed of vehicle • Current speed of vehicle in front • Reading from sensor • Driver actions (e.g. moving wheel/braking) • Direction the car (in front) is travelling (e.g. turning)	3	'speed' or 'distance' on its own is NE BOD reference to a camera taking images of what is in front <u>Examiner's Comments</u> Candidates were told that the system stores currently running data and instructions in RAM and required an application of that data to the given scenario. The most common responses related to the speed of the car and the distance between the cars. Some candidates identified that the speed of the car in front was stored as well as the current speed of that car. Some candidates identified other data that could be stored in the RAM, for example whether the driver has control, if the system is currently active as well as data that would be needed to identify which car is being followed.
		iii	1 mark each to max 2 • Only stores a small amount of data in RAM // only stores specific/few items in RAM • … unlikely to run out of RAM // there is enough space in RAM • No secondary storage to use/needed as VM • Few/one program/instructions running at a time // no memory intensive tasks • Dedicated hardware will be optimised for system // RAM is designed to meet the system's requirements	2	<u>Examiner's Comments</u> Many candidates were able to identify that VM is used when a system is short of RAM, they were then able to apply this to the given system, i.e. that the current system will not run out of RAM. Some candidates expanded this by also identifying that very few data items would be stored in RAM. Some of the stronger responses included an acknowledgement that the embedded system is unlikely to have secondary storage and therefore cannot create VM.
			Total	10	