



Mark Scheme

Summer 2024

Pearson Edexcel International GCSE
In Computer Science (4CP0/01)

Paper 01: Principles of Computer Science

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Additional Guidance	Mark
1(a)	Award one mark for any of the following up to a maximum of two marks: • WANs cover large/wide (geographic) distances/areas / LANs cover small/local (geographic) distances/areas (1) • WANs have lower bandwidth / LANs have higher bandwidth (1) • WANs connect multiple LANs / LANs are single networks (1) • WANs have higher latency / LANs have lower latency (1) • WANs use shared infrastructure / LANs are usually privately owned (1) • WANs use third party connections / LANs are owned by the organisation (1) • WANs have more users/devices / LANs have fewer users (1)	<u>Do not</u> award 2 marks for the same point e.g. A WAN is used over a large geographic area whereas a LAN covers a small distance. Two <u>different</u> differences must be identified. Do not accept general points such as WANs are slower - too vague. Do not accept LANs can be wireless.	2
1(b)	Award one mark for any of the following: • (Increased risk of) malware/viruses spreading / Pharming / Cyber attack (1) • (Increased risk of) hacking/unauthorised access/interception (1)		1
1(c)(i)	Award one mark for: • (Partially connected) mesh (1)		1

1c(ii)	Award one mark for any of the following: • More expensive to install (1) • Needs more cabling/wiring (1) • Requires more maintenance (1) • Harder to maintain / manage / install (1) • Higher power consumption (1)		1
1(c)(iii)	Award up to two marks for a linked explanation such as: • In the event of a damaged/congested connection data/packets can still be routed to their destination (1) because each node/computer is connected to at least two other nodes / there are multiple pathways available (1)		2
1(d)	The only correct answer is D <i>A is not correct because the application layer deals with applications</i> <i>B is not correct because the transport layer deals with packet structure</i> <i>C is not correct because the network layer deals with routing end to end</i>		1
1(e)(i)	Award one mark for: • https/hypertext transfer protocol secure (1)		1
1(e)(ii)	Award one mark for: • specification(.html) (1)		1
Total for question 1			10

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	Award one mark for any of the following: • To perform end user related tasks (1) • To help the user be more productive/creative/communicative (1)	Do not award trade names or generic categories of software Allow software examples such as word processor if it is clear that it is an end-user task. Do not award responses related to tasks that could be performed by pen/paper.	1
2(a)(ii)	Award one mark for any of the following up to a maximum of three marks: • Process management (1) • Memory management/virtual memory (1) • File management (1) • Peripheral/hardware management (1) • Network management (1) • Security management (1) • User management (1)	Allow equivalence to management such as ‘scheduling processes’, ‘Virtual memory organisation’, but do not award terms in isolation. Do not award marks for types of OS such as multitasking Do not award UI as given in question.	3

2(b)(i)	Award up to two marks for a linked explanation such as: • RAM is volatile/its contents will be lost when the power is switched off (1) ROM (is permanent) is required to store the BIOS/firmware/to boot up the computer (1) • The contents of ROM cannot be changed (1) RAM is required for actively executing programs and data (1)	Both RAM and ROM must be addressed for 2 marks.	2
2(b)(ii)	Award one mark for any of the following up to a maximum of three marks: • A platter is used (1) • (The platter) is divided into tracks / sectors (1) • A read/write arm/head is moved (to the track required) (1) • A read/write head reads the values (from the surface) (1) • One polarity represents 1 and other polarity represents 0 (1)	Accept North/South for polarity and representation of binary state.	3

2(c)	Award one mark for each correct row: <table><tr><th>Stage</th><th>Sequence Number</th></tr><tr><td>The instruction is placed onto the data bus</td><td>2</td></tr><tr><td>The Arithmetic and Logic Unit (ALU) performs a calculation</td><td>4</td></tr><tr><td>The address of the next instruction is placed onto the address bus</td><td>1</td></tr><tr><td>The instruction is decoded by the control unit</td><td>3</td></tr></table>	Stage	Sequence Number	The instruction is placed onto the data bus	2	The Arithmetic and Logic Unit (ALU) performs a calculation	4	The address of the next instruction is placed onto the address bus	1	The instruction is decoded by the control unit	3		4
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2(d)	The only correct answer is A <i>B is not correct because the control bus is bidirectional</i> <i>C is not correct because the system bus is a collective term that contains both unidirectional and bidirectional buses</i> <i>D is not correct because the data bus is bidirectional</i>		1										
Total for question 2			14										

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	Award one mark for any of the following: • 256 (1) • 2^8 (1) • $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$ (1)		1
3(a)(ii)	Award one mark for each of the following up to a maximum of three marks: • 1920 x 1080 in the numerator (1) • x 16/8 (16 in the numerator and 8 in the denominator) or (2 in the numerator) (1) • / (1024 x 1024) in the denominator (1) 1920 pixels x 1080 pixels x 8 bits / 8 bits per byte / 1024 x 1024 bytes per MiB $\frac{1920 \times 1080 \times \frac{16}{8}}{1024 \times 1024}$	Max 2 marks if not a fully correct expression. Allow equivalence e.g. $1024 = 2^{10}$ $1024^2 = 2^{20}$ 2^{-20} is equivalent to $1/2^{20}$	3
3(a)(iii)	The only correct answer is C <i>A is not correct because the MSB is 1 so the denary value must be more than 128</i> <i>B is not correct because the LSB is 0 so the denary value must be even</i> <i>D is not correct because the denary number is signed</i>		1

3(b)(i)	Award one mark for each of: - Negative sign (1) 63 (1) Example: - 63		2
3(b)(ii)	Award one mark for: 1000 0010 (1)		1
3(b)(iii)	Award up to two marks for a linked explanation such as: An overflow error has occurred (1) because the result requires more bits to store than are available (1)		2
3(c)(i)	Award one mark for any of the following: 011 0101 (1) 53 (1) - Hex value of 35 (1) Do not accept 11 0101 (six bits, ASCII is at least seven)		1

3(c)(ii)	Award one mark for any of the following up to a maximum of two marks: • It is a standard/universal encoding method (1) • It can represent all the characters in the English alphabet (1) • It only uses 7/8 bits per character (1) • It can represent 128/256 characters (in standard/extended format) (1) • It takes up less storage space than Unicode (1) • It can be used with bit masking (1) • It is compatible with UTF-8 (1)		
Total for question 3			2
			13

Question Number	Answer	Additional Guidance	Mark
4(a)	Award up to two marks for a linked explanation such as: • ‘What-if’ questions can be asked by changing variables (1) to make predictions / see trends (1) • The simulation can be rerun with different values (1) to see how the outcomes will change (1) • The simulation can be run faster than real life (1) so multiple generations of animal results can be seen / long-term trends seen (1) • The simulation can be safer (1) because of the danger of animal interaction (1) • The simulation would be more convenient / saves time (1) because observers would have to be present outside for a long time (1)	Looking for a relevant statement and a linked extension/expansion. Do not award two independent statements that are not linked. Points could be reversed such as: you can make predictions because variables can be changed to see how the outcome will differ.	2
4(b)	The only correct answer is C <i>A is not correct because it is not a linear scenario</i> <i>B is not correct because parallel models do not have to communicate and coordinate their actions</i> <i>D is not correct because there is not an explicit input with an expected output</i>		1

4(c)	Award up to two marks for a linked description such as: • The research facility could use Two/Multi Factor Authentication (2FA/MFA) (1) sending a secondary piece of data to the employee which they then enter (e.g. passcode / authenticator app / email) (1) • Using a username and password (1) that is unique to each individual employee / that matches one stored in a database (1) • The research facility could implement a security question (1) that only the employee would know the answer to (1)	Do not allow any biometric measure e.g. fingerprint - biometrics is given in the question. Do not accept password on its own - this is insufficient to allow the user's identity to be authenticated	2
4(d)(i)	Award one mark for any of the following: • The manipulation of matter with a size from 1 to 100 nanometres / scale of 10^{-9} / at atomic/molecular level (1) • The inclusion of nanoparticles into different materials (1) • Facilitates miniaturisation at atomic/molecular scale/level (1)	Small/miniature/microscopic is not enough. Responses must relate to the scale at the nano/molecular/atomic level.	1
4(d)(ii)	Award one mark for any of the following: • Stronger materials e.g. scratch resistant coatings / self-cleaning glass (1) • Miniaturisation of electronics e.g. transistors (1) • Nanomedicines to deliver drugs (1)	Allow examples that reasonably map to the categories given.	1

4(e)	Award one mark for each of the following up to a maximum of three marks: • It uses a total of 128 bits (1) • There is a total of 32 hexadecimal character (1) • Each hexadecimal character requires 4 bits (1) • There are 8 blocks of 4 character / 8 x 4 blocks (1) • Each block (of 4 character) requires 16 bits (1) • The address uses 4 (bits per character) x 32 (characters) / 4 x 32 (1) • Each of the 8 blocks uses 16 bits / 8 x 16 (1)		3
4(f)	Indicative content • Rights and responsibilities • Data Protection regarding personal data • Surveillance • Consent of the individual to having specified data held • Accountability of those running / using such systems • Ownership • Data mining & analysis of work patterns and potential use/misuse • Ethics versus the legality of implementing such systems • Data misuse and protection against hacking and malware • Requirement to keep data secure • Physical access to areas of the site • Monitoring employee movement to restricted areas / resources • Algorithmic bias in facial recognition		6
Total for question 4			16

Level	Mark	Descriptor
	0	No rewardable content.
Level 1	1-2	Basic, independent points are made showing elements of knowledge and understanding of key concepts/principles of computer science. The discussion will contain basic information with little linkage between points made.
Level 2	3-4	Demonstrates adequate knowledge and understanding of key concepts/principles of computer science. The discussion shows some linkages and lines of reasoning with some structure.
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting relevant knowledge and understanding of key concepts/principles of computer science to support the discussion being presented. The discussion shows a well-developed, sustained line of reasoning which is clear, coherent, and logically structured.

Question Number	Answer	Additional Guidance	Mark																								
5(a)	Award one mark for each correct column: <table border="1"> <thead> <tr> <th></th><th colspan="3">Translator</th></tr> <tr> <th>Characteristic</th><th>Assembler</th><th>Interpreter</th><th>Compiler</th></tr> </thead> <tbody> <tr> <td>Does not have to be present in memory to execute the translated code.</td><td>✓</td><td></td><td>✓</td></tr> <tr> <td>Translates high level language source code.</td><td></td><td>✓</td><td>✓</td></tr> <tr> <td>Executes high level code until either the program has finished, or a syntax error is encountered.</td><td></td><td>✓</td><td></td></tr> <tr> <td>Translates low level language source code into machine code.</td><td>✓</td><td></td><td></td></tr> </tbody> </table>		Translator			Characteristic	Assembler	Interpreter	Compiler	Does not have to be present in memory to execute the translated code.	✓		✓	Translates high level language source code.		✓	✓	Executes high level code until either the program has finished, or a syntax error is encountered.		✓		Translates low level language source code into machine code.	✓				3
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Translates low level language source code into machine code.	✓																										
5(b)	Award two marks for a linked explanation such as: - Fewer instructions are executed per second (1) so gameplay will not appear to execute as smoothly / graphics lag / fewer frames per second / can only handle less complex graphics (1) - Consoles will execute more instructions per second / have faster processors / GPUs (1) so gameplay will not be realistic / mirrored / fair comparison (1)	One mark can be awarded processing speed implication, but the second mark is dependent on having a gameplay impact being identified. e.g. "A lower clock speed means processing will take longer" is generic for one mark. Low performance on its own is not enough.	2																								

5(c)	Award one mark for each correct cell: <table><tr><th>Issue</th><th>Utility software</th></tr><tr><td>Her word processor cannot read all of the files because it is corrupt.</td><td>File repair/recovery</td></tr><tr><td>She has a JPEG image and needs to send it to a publisher who can only read PNG image files.</td><td>Converting</td></tr><tr><td>There has been a flood and files on a server have been damaged, but Anna needs to access her data.</td><td>Backup/restore</td></tr><tr><td>Anna's hard drive is running very slowly when she tries to access a file.</td><td>Defragmentation/defrag</td></tr></table>	Issue	Utility software	Her word processor cannot read all of the files because it is corrupt.	File repair/recovery	She has a JPEG image and needs to send it to a publisher who can only read PNG image files.	Converting	There has been a flood and files on a server have been damaged, but Anna needs to access her data.	Backup/restore	Anna's hard drive is running very slowly when she tries to access a file.	Defragmentation/defrag		4
Issue	Utility software												
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There has been a flood and files on a server have been damaged, but Anna needs to access her data.	Backup/restore												
Anna's hard drive is running very slowly when she tries to access a file.	Defragmentation/defrag												
5(d)	Award one mark for: • Lossless (1) Award one mark for any of the following up to a maximum of two marks: • No data will be lost / the process is reversable (1) • The manual will still be readable (1) • Removal of data would change the meaning of text (1) • Proofreader will be able to edit the text (1)	Allow converse if candidate gives reasons why lossy would not be used for justification Allow RLE as a valid lossless compression method.	3										

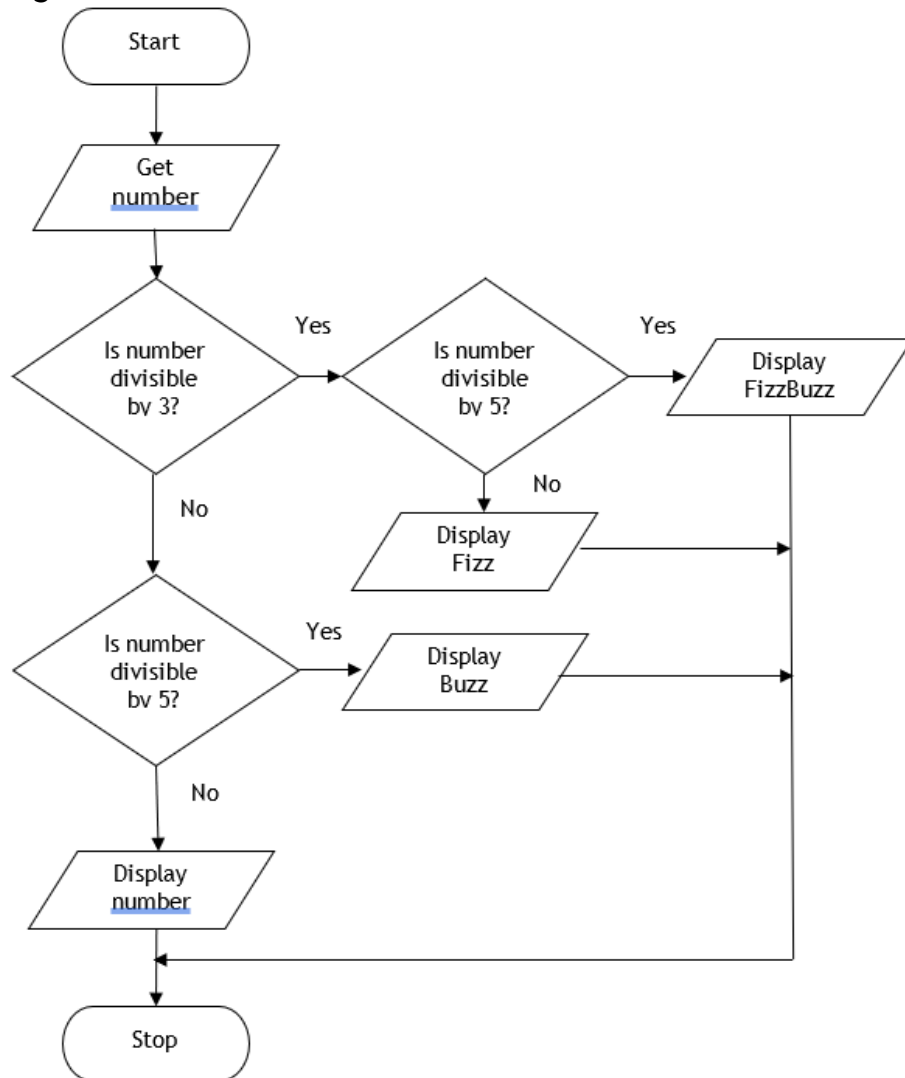
5(e)	Award one mark for each of: Method 1 • (C AND NOT D) (1) • (NOT C AND D) (1) • <expr1> OR <expr2> (1) Method 2 • (C OR D) (1) • NOT (C AND D) (1) • <expr1> AND <expr2> (1) Example statements: (C AND NOT D) OR (NOT C AND D) (C OR D) AND NOT (C AND D)	Order of precedence is NOT, AND, OR Note other equivalent solutions MAX 2 if all terms correct apart from missing brackets that are required. Do not credit circuit diagrams.	3
Total for question 5			15

Question Number	Answer	Additional Guidance	Mark
6(a)	The only correct answer is D <i>A is not correct because it is not a REPEAT UNTIL / DO WHILE loop</i> <i>B is not correct because it is not a FOR loop</i> <i>C is not correct because there is no such loop</i>		1
6(b)(i)	Award one mark for any of the following: • WHILE NOT (index >= LENGTH(arrival)) • WHILE NOT (index > LENGTH(arrival)-1) • WHILE index < LENGTH(arrival) • WHILE index <= LENGTH(arrival)-1	Allow hard coded values for the number of items in the list. For example, index >= 7 index > 6	1
6(b)(ii)	Award one mark for any of the following: • IF arrival[index] > 0 • IF arrival[index] >= 1		1
6(b)(iii)	Award one mark for: • late is incremented (1) SET late TO late + 1		1

6(b)(iv)	Award one mark for: On time is calculated as the remainder when early and late trains are subtracted from the total number of trains (1) <code>LENGTH(arrival) - (late + early)</code>	Allow number of trains to be hard coded as 7 in place of <code>LENGTH(arrival)</code> Allow equivalent expressions: <code>LENGTH(arrival) - late - early</code>	1
6(c)	Award one mark for any of the following: - Otherwise there would be an infinite loop (1) - It is used to index all elements in the <code>(arrival)</code> array (1) - To access the next value in the <code>(arrival)</code> array on the next iteration (1) - So that the condition used in the while loop evaluates to True when all the elements in arrival have been processed (1)		1

6(d)	Award one mark for each up to a maximum six marks: • Get number immediately follows start (1) • Number divisible by 3 and number divisible by 5 → Display Fizz (1) • Number divisible by 3 and number divisible by 5 → Display Buzz (1) • Number divisible by 3 and number divisible by 5 → Display FizzBuzz (1) • Number not divisible by 3 and number not divisible by 5 → Display n (1) • The flowchart represents a fully functional solution (1)	For last mark point: All symbols fully connected with directed arrows. Start and stop terminators used correctly. No hanging symbols. Decision boxes have exactly two labelled outputs For each of the first five mark points the mark should only be awarded if there is one correct logical path to get to the outcome. DO NOT credit a point if additional symbols have been added.	
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e.g.



Total for question 6

6
12

