Paper 1: Principles of Computer Science

Question number	Answer	Additional guidance	Mark
1(a)	Any **one** from: • non-English characters can't be represented • 7/8 bits can't represent all characters • not enough bits to represent all characters.		**(1)**

Question number	Answer	Additional guidance	Mark
1(b)			

Plain text	Shift	Cipher text
WINDOW	+4	AMRHSA (1)
DRIVE (1)	-3	AOFSB
CACHE	+2 (1)	ECEJG

(3)

Question number	Answer	Additional guidance	Mark
1(c)	4S 1B 2W	Accept S4 B1 W2	**(1)**

Question number	Answer	Additional guidance	Mark
1(d)	A 0 1 0 0 1 1 0 1		**(1)**

Question number	Answer	Additional guidance	Mark
1(e)	Any **one** from: • data is permanently removed • original cannot be reconstructed.		**(1)**

Question number	Answer	Additional guidance	Mark
2(a)	1 mark for extending the given pattern in the question. 1 mark for the correct number of patterns. $$2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8 \times 2^8$$ 1 mark for 2^{16}. 1 mark for correct number of patterns. $$2^{16} \times 2^{16} \times 2^{16} \times 2^{16} \times 2^{16} \times 2^{16} \times 2^{16} \times 2^{16}$$ 1 mark for each correct exponent. $(2^8)^{16}$ $(2^{16})^8$ 2^{128}		**(2)**

Question number	Answer	Additional guidance	Mark
2(b)(i)	C 1 1 0 0 0 1 0 0		**(1)**

Question number	Answer	Additional guidance	Mark
2(b)(ii)	D 0 1 1 0 1 1 0 0		**(1)**

Question number	Answer	Additional guidance	Mark
2(c)	Any **one** from: • data packets only travel in a single direction from node to node (so there are no packet collisions) • only one machine at a time can use the network (because it uses a token-passing mechanism)		(1)

Question number	Answer	Additional guidance	Mark
2(d)(i)	1 mark for the correct order (highest to the lowest). 1 Transport 2 Network 3 Data Link		(1)

Question number	Answer	Additional guidance	Mark
2(d)(ii)	Application		(1)

Question number	Answer	Mark
3(a)	Indicative content Cloud storage is most suitable. Accessibility: • it is accessible whenever and wherever an internet connection is available • the team's devices probably support mobile data, then they will always have access to their documents • can work with data locally (offline) and upload/re-synchronise documents. Collaboration: • the team can work on documents at the same time, which is good for multiple field workers entering/reading data at the same time. File compatibility: • applications can be used online instead of having native ones on each device • that way, there is no conversion of file types necessary. Online apps: • the online applications can be used to edit online stored data files • there may be cost savings by using online applications instead of buying individual ones for each of the devices. Backups: • documents on the cloud will be backed up without the user having to think about it.	**(6)**

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 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 that is clear, coherent and logically structured.

Question number	Answer	Additional guidance	Mark
3(b)	A WAN		(1)

Question number	Answer	Additional Guidance	Mark
3(c)	Any **two** from: - some areas not covered by required infrastructure - inconsistent connection due to interference - speed of uploading/downloading large files; may be slower than other networks - the cost of uploading/downloading large files may be prohibitive - there is a significant difference in upload and download speeds - there is some concern about the health risks of heavy use of wireless technologies (magnetic waves).		(2)

Question number	Answer	Additional guidance	Mark
3(d)	Client server (model)		**(1)**

Question number	Answer	Additional guidance	Mark
3(e)	Any **one** from: • the team could use the model to predict/track (1) numbers of wildlife over time (1) • the team could research the impact of changing variables (such as the amount of food available) (1) on the numbers of wildlife (1) • the team could predict the impact (1) of the increase/decrease of one type of wildlife on other types (1) • the team could look for trends (1) in the numbers/types of wildlife (1) • the team could investigate the possible impact of changing variables (1) such as amount of foods/temperatures/rainfall (1).	Accept prediction, analysis of historical data to show trends, the effects of one variable compared to another.	**(2)**

Question number	Answer	Additional guidance	Mark
4(a)(i)	A = Clock (1) B = Address Bus (1) C = Data Bus (1) D = Arithmetic Logic Unit/ALU (1)		**(4)**

Question number	Answer	Additional guidance	Mark
4(a)(ii)	Any **one** from: • the cache queues instructions/holds data ready for use (1) so that it speeds up the processing (1) • the cache speeds up the processing/speed matching (1) by making up for the difference in speed of the memory on the chip and the RAM memory (1).	Do not accept web cache, hard drive cache.	**(2)**

Question number	Answer	Additional guidance	Mark
4(b)	Any **two** from: • antivirus software should be installed • antivirus software should be run/his disc should be scanned to identify the virus • a virus removal tool could be used (to remove or quarantine the virus from his machine) • antivirus software/signature files should be kept up to date (to make sure any new malware programs are detected).		**(2)**

Question number	Answer	Additional guidance	Mark
4(c)(i)	C Embedded		**(1)**

Question number	Answer	Additional guidance	Mark
4(c)(ii)	Any **one** from: • receivers can be placed at intervals down the golf course (1). When the golf ball passes one of the receivers, the receiver can register the distance (1) • a hand-held receiver could be carried by a golfer so that if he/she lost a golf ball (1), they could use the receiver to detect the location (1).		**(2)**

Question number	Answer	Additional guidance	Mark
5(a)	A description that incorporates a concept, such as: • the use of technology gives access to a wider range of individuals (local and globally) (1) outside our normal social circumstances (1) • the use of technology gives access to individuals with common interests (1) to promote a feeling of belonging (1) • the use of technologies provides access to services (e.g. education, government, health, charities) (1) for those with constraints (e.g. geographical time, monetary constraints, disabilities) (1) • the use of accessibility/adaptive technologies for disabilities (1) allows people to participate more fully in society (1) (e.g. haptic devices (phone vibrates), communication devices, locked-in syndrome) • the use of technologies as alternative infrastructures (1), may provide important services in areas without more conventional infrastructure (1).	Examples of infrastructure may include service infrastructures and alternatives, e.g. mobile money, non-smartphones, works by SMS messaging, e.g. M-Pesa or physical telecommunication infrastructures, e.g. VOIP (socket stack, smartphone)	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(i)	1 mark for each correct column. 	S	T	NOT S	NOT S OR T
0	0	1	1
0	1	1	1
1	0	0	0
1	1	0	1			**(2)**

Question number	Answer	Additional guidance	Mark
5(b)(ii)	Any **one** from: • (T AND L) OR (S AND L) • L AND (T OR S) • T OR S AND L		**(1)**

Question number	Answer	Additional guidance	Mark
5(b)(iii)	38 To bin: 0010 0110 (1) Flip bits: 1101 1001 (1) Add 1: 0000 0001 -38: 1101 1010 (1) Alternative solution (Subtraction from 2^n where n=8 bits) Formula: 2^n - 38 Substitution: 2^8 – 38 (1) Calculation: 256 - 38 = 218 (1) To binary: 1101 1010 (1)	Correct answer only gains 3 marks.	**(3)**

Question number	Answer	Additional guidance	Mark
6(a)	B Pixel		(1)
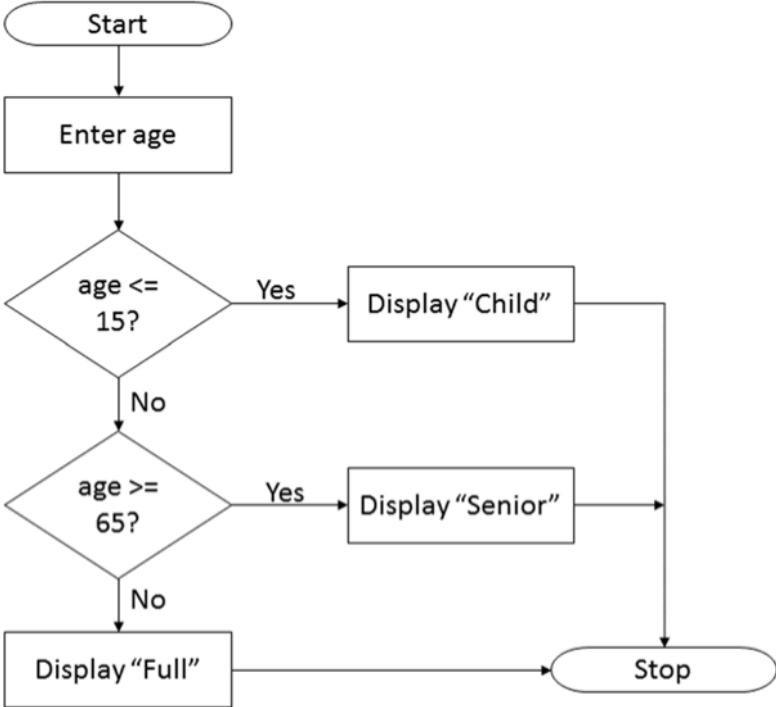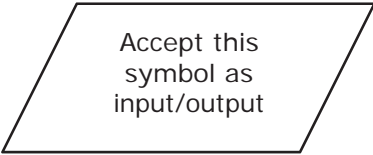
Question number	Answer	Additional guidance	Mark
6(b)	There are only four different representations (that can be displayed as 2 bits) (1), which are 00, 01, 10, 11 (1)		(2)

Question number	Answer	Additional guidance	Mark
6(c)	Award 1 mark for each stage of the process. (4 mebibytes) $\left(\dfrac{1024 \text{ kibibytes}}{1 \text{ mebibyte}}\right)\left(\dfrac{1024 \text{ bytes}}{1 \text{ kibibyte}}\right)\left(\dfrac{8 \text{ bits}}{\text{byte}}\right)$ <table><tr><td></td><td></td><td>(1) ×</td><td></td><td>(1) ×</td><td></td><td>(1) ×</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td>1024</td><td></td><td>1024</td><td></td><td>8</td></tr></table>	• Ignore attempts to calculate. • Units not required. • Equivalent expressions awarded. • No marks awarded for 4 mebibytes as this is given in the paper.	(3)

Question number	Answer	Additional guidance	Mark
6(d)	An explanation that incorporates the following concepts (to a maximum of 4 marks total): • the analogue sound is a continuous wave (1) • to convert it, the amplitude (1) of the signal is sampled (at different points) (1) • the sampled value is converted to binary digits (1) • therefore, some parts of the analogue signal will not be represented by samples (in the file) (1).		(4)

Question number	Answer	Additional guidance	Mark
7(a)(i)	1 mark for each correct output. <table><tr><td>**Input**</td><td>**Output message**</td><td></td></tr><tr><td>0</td><td>Answer is 1</td><td>(1)</td></tr><tr><td>-12</td><td>Invalid input</td><td>(1)</td></tr><tr><td>5</td><td>The answer is 120</td><td>(1)</td></tr></table>		**(3)**

Question number	Answer	Additional guidance	Mark
7(a)(ii)	Any **one** from: • multiplies every number between 1 and inNum. • calculates factorial of inNum.		**(1)**

Question number	Answer	Additional guidance	Mark
7(b)	Indicative content Award 1 mark for: • start and input of age (1) • decision with correct logic and output for child passenger (1) • decision with correct logic and output for senior passenger (1) • correct logic and output for all other passengers and Stop (1) • correct usage of symbols (1).	Accept this symbol as input/output	**(5)**

Question number	Answer	Additional guidance	Mark
7(c)	1 mark for each **two** correct responses up to a maximum of 3 marks.		

Characteristic	Translators		
	Compiler	Interpreter	Assembler
An error in the source code is highlighted as soon as it is encountered during execution.		✓	
Translates low-level programming languages.			✓
Translates high-level programming languages.	✓	✓	
Generates a single executable file.	✓		
One line of source code is translated to one line of machine code.			✓

(3)

Question number	Answer	Additional guidance	Mark
8(a)	D Firewall		(1)

Question number	Answer	Additional guidance	Mark
8(b)	An explanation that makes reference to any **one** from: • security vulnerabilities in the network are exposed (1) by someone who is paid/rewarded to do it/ethical hacker (1) • identify problems/flaws with the network (1) so that vulnerability can be addressed (1) • security vulnerabilities are exposed and addressed (1) before being made public (1).		(2)

Question number	Answer	Additional guidance	Mark
| 8(c) | (number >= 1)                              (1)<br>Boolean operator  AND                 (1)<br>(number <= 12)                            (1)<br>Both instances of  [number  −1]      (1)<br><br>```
12      IF (number >= 1) AND (number <= 12) THEN
13          SET month TO monthNames[number - 1]
14          SET days TO monthDays[number - 1]
15
``` | | (4) |

Question number	Answer	Additional guidance	Mark
8(d)	Indicative content Development cycle: • security should be considered throughout the development cycle • the requirement for security can be agreed as one of the initial requirements • security should be factored into the design of the application. Programming languages: • programming languages, just like other software, may have security loopholes in them • as the application is being developed, the programmers should make sure that any unsecure parts of the language are not used • when they know of language changes, they must incorporate them as quickly as possible • use appropriate settings on language translators. Programming habits: • bad programming habits by the programmers themselves can lead to problems • one way around this is special review sessions that focus only on security • bad programming practices need to be addressed and amended to keep the application secure • the simpler the code structure is, the fewer issues that will be exposed once the application is released (Cyclomatic complexity). Tracking: • when the application is being developed, it is important to be able to track who made what changes and when • these audit trails should be kept as the code is changed • it means that if a security issue arises, it can be tracked back to the version of the code that first had it. Testing: • modular testing is a way to help keep code secure • the smaller the units of testing, the more likely a security issue is to be found • test for boundary conditions and handle exceptions appropriately • use all available code analysis tools.		(6)

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