UNIT 1 - UNDERSTANDING COMPUTER SCIENCE

MARK SCHEME

Guidance for examiners

Positive marking

It should be remembered that learners are writing under examination conditions and credit should be given for what the learner writes, rather than adopting the approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

For questions that are objective or points-based the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

For band marked questions mark schemes are in two parts.

Part 1 is advice on the indicative content that suggests the range of computer science concepts, theory, issues and arguments which may be included in the learner's answers. These can be used to assess the quality of the learner's response.

Part 2 is an assessment grid advising bands and associated marks that should be given to responses which demonstrate the qualities needed in AO1, AO2 and AO3. Where a response is not credit worthy or not attempted it is indicated on the grid as mark band zero.

Banded mark schemes

Banded mark schemes are divided so that each band has a relevant descriptor. The descriptor for the band provides a description of the performance level for that band. Each band contains marks.

Examiners should first read and annotate a learner's answer to pick out the evidence that is being assessed in that question. Once the annotation is complete, the mark scheme can be applied.

This is done as a two stage process.

Stage 1 – Deciding on the band

When deciding on a band, the answer should be viewed holistically. Beginning at the lowest band, examiners should look at the learner's answer and check whether it matches the descriptor for that band. Examiners should look at the descriptor for that band and see if it matches the qualities shown in the learner's answer. If the descriptor at the lowest band is satisfied, examiners should move up to the next band and repeat this process for each band until the descriptor matches the answer.

If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the learner's response should be used to decide on the mark within the band. For instance if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content. Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

Stage 2 – Deciding on the mark

Once the band has been decided, examiners can then assign a mark. During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a learner's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Indicative content is also provided for banded mark schemes. Indicative content is not exhaustive, and any other valid points must be credited. In order to reach the highest bands of the mark scheme a learner need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

Q	Answer	Marks	AO1	AO2	AO3	Total
1	**One mark for each correct response** • They are easier to understand, learn and program as commands are more similar to natural language - TRUE (box 1) • They require less time for translation into machine code - FALSE (box 4) • They are preferred when the execution speed is critical - FALSE (box 6)	1 1 1	1 1 1			3
2a	**One mark for each point** **No marks for naming component. Mark awarded for purpose of each. If purpose provided without naming component, award mark** • Component A: Arithmetic Logic Unit The ALU performs all the mathematical calculations and logical operations in the CPU. • Component B: Register Register is a storage location found on the CPU where data or control information is temporarily stored. (Registers are usually much faster to access than internal memory) • Component C: Control unit Directs the flow of instructions and/or data / Coordinates the other parts of the CPU / Generates clock ticks or controls the clock	1 1 1	1 1 1			3

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Q	Answer	Marks	AO1	AO2	AO3	Total
2b	**One mark for each point**					6
	Cache size					
	• More cache memory improves the performance as it can provide instructions and data to the CPU at a much faster rate than other system memory such as RAM.	1	1			
	• More cache memory will allow more instructions that are repeatedly used by a CPU to be stored, and therefore increase the hit rate; increasing performance as a result.	1	1			
	Clock speed					
	• The faster the clock speed, the faster the computer is able to run the fetch-decode-execute cycle and therefore process more instructions.	1	1			
	• The faster the clock speed, the more power is generally required which creates greater requirements for heat dissipation and can place more strain on battery life.	1	1			
	Number of cores					
	• In a single-core CPU each instruction is processed one after the other, whereas in a dual-core CPU, two instructions may be processed at the same time. In theory, dual-core CPU should mean that the computer can process instructions twice as fast as a single-core CPU.	1	1			
	• Performance may be affected where one core is waiting on the result of another and therefore cannot carry out any more instructions, leading to the performance being no better than a single core processor.	1	1			
2ci	**One mark for each point**					2
	• Sound cards are specialised electronic circuits designed to generate analogue waveforms from digital data	1	1			
	• Sound cards provide the input and output of audio signals to and from a computer system.	1	1			
2cii	**One mark for each point**					2
	• A motherboard provides connections between many of the components used by computer systems,	1	1			
	• such as the CPU, memory, hard disc interface, expansion slots and other peripherals.	1	1			

Q	Answer	Marks	AO1	AO2	AO3	Total

3	**Two marks for each description x 2**
	One mark for each example x 2
	
	Logical error
	• Description: A logical error is a mistake in the program instructing the program to do the wrong thing (1) so the program works but produces the wrong output (1)
	• Example: GrossPrice = NetPrice – VAT instead of GrossPrice = NetPrice + VAT
	
	Note: example must show both correct and incorrect code
	
	Execution error
	• Description: An execution error is when the program unexpectedly stops (1) as a result of an invalid operation during execution (1)
	• Example: Attempt to read past the end of file / attempt dividing by zero
	
	Rounding error
	• Description: A rounding error is when the program rounds a real number to a fixed number of decimal places (1) resulting in losing some information as the number becomes less accurate (1)
	• Example: 3.125 rounding to 3.13
	
	Truncation error
	• Description: A truncation error is when the program truncates a real number to a fixed number of decimal places (1) resulting in losing some information as the number becomes less accurate (1)
	• Example: 3.125 truncating to 3.12
	
	Linking error
	• Description: A linking error occurs when a compiler can't find the sub procedure (1) as the programmer might have declared it incorrectly / did not instruct the compiler to include the sub program (library) in the code. (1)
	• Example: `math.sqrt(4)` when the math library has not been included in the code
	or
	`declare FindLargst()`
	`Call FindLargest()`
	
	Accept other suitable examples of programming errors
	<u>NOT</u> syntax error as precluded by question.
		4
		2
			4
			2
						6

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Q	Answer	Marks	AO1	AO2	AO3	Total
4	**One mark for each correct data type x 3** **One mark for each suitable <u>different</u> validation check x 3**	3 3		3 3		6

Field name	Data type	Example data	Validation check
Customer ID	**Integer**	3	**Type check**
First Name	String	Warren	Presence check
Surname	String	Davies	Presence check
Gender	**Character**	M	Presence check
Date of birth	Date	28/11/1981	**Range check**
Address	String	123 Western Avenue	Presence check
Post code	String	CF12 3DT	**Format check**
Telephone number	**String**	029 2026 5137	Length check

Alternative approach:

Field name	Data type	Example data	Validation check
Customer ID	**Integer**	3	**Range check**
First Name	String	Warren	Presence check
Surname	String	Davies	Presence check
Gender	**Character**	M	Presence check
Date of birth	Date	28/11/1981	**Format check**
Address	String	123 Western Avenue	Presence check
Post code	String	CF12 3DT	**Type check**
Telephone number	**String**	029 2026 5137	Length check

5a	**One mark for each point**	2	2			4
	• Prevent physical access to the keyboard input port, e.g. USB (1), to eliminate the risk of pass through connectors, which captures the key presses (1).					
	• Prevent the installation of device drivers or other low level software (kernel hacks) (1) which records input via the keyboard to a file (1).	2	2			
	• Use a Bluetooth-enabled keyboard (1), in order to encrypt keystrokes during transit (1).	2	2			

Q	Answer	Marks	AO1	AO2	AO3	Total
5b	**One mark for each point up to a maximum of two marks**	2	2			2
	• A computer program that copies itself from one to program to another on a computer system					
	• Computer viruses need to attach themselves to an existing program					
	• Viruses often infect computers by exploiting bugs / security failures in legitimate software.					
6a	**One mark for correct workings x 3 (All valid methods accepted)**	3		3		6
	One mark for correct conversion x 3	3		3		

Denary	Binary	Hexadecimal
104_{10}	01101000_2	68_{16}
77_{10}	01001101_2	$4D_{16}$
28_{10}	**00011100_2**	$1C_{16}$
147_{10}	10010011_2	**93_{16}**

6bi	**One mark for correct workings**	1		1		2
	One mark for correct answer	1		1		

```
         01011101
         00010011
  Answer 01110000
   Carry 00111110
```

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6bii	**One mark for each:**
	• Choose two suitable binary numbers which, when added, will cause overflow
	• Correct addition of the two chosen binary numbers
	
	Worked example:
	
	        `11000101`
	        `10110011`
	Answer `01111000`
	Carry **1**`00001110`
	
	• Identifying that a carry on the most significant bit (MSB) has occurred
	• CPU detects that a carry has occurred and sets the overflow flag to true.
		1
		
		1
		
		1
		
		1
				1
				
				1
				
				1
				
				1
							4

6ci	**One mark for each:** `10111100`$_2$ The effect is to multiply the number by 2.	1 1		1 1			2

Q	Answer	Marks	AO1	AO2	AO3	Total
6cii	**One mark for each:** 00001111$_2$ The effect is to divide the number by 4.	 1 1		 1 1		2
7	**One mark for each:** • The OS manages output devices by communicating with and sending data output from a printer, monitor or other valid output device. • The OS manages the backing store by ensuring that files and data can be stored and retrieved correctly by maintaining a filing system such as FAT or NTFS. • The OS manages the CPU by ensuring that programs are given sufficient time to execute instructions and that interrupts are handled by the CPU as necessary.	 1 1 1	 1 1 1			3
8a	**One mark for each:** • Sampling is a method of converting an analogue sound signal into a digital file. • At specific intervals (frequency) a measurement of the amplitude (bit depth) of the signal is taken. • The higher the sampling rate / bit depth the better the quality of the sound file	 1 1 1	 1 1 1			3
8b	**One mark for each:** • The amplitude of each sound sample is converted into the equivalent binary number. • The whole collection of data (binary numbers) is then stored in a digital file.	 1 1	 1 1			2
8c	**One mark for each up to a maximum of two:** • Artist • Title / Track Title • Product / Album Title • Track Number • Date Created / Year • Genre • Comments • Copyright • Software • Type • Duration • File size • Bit rate • Sampling rate • Channels • Volume	 1 1	 1 1			2
8di	**One mark for each:** • Sound files are compressed using a lossy algorithm by analysing the waveform and removing sound that cannot be heard by people. • To increase the compression, lossy algorithms remove more data which reduces the quality of the sound file (lowers fidelity)	 1 1		 1 1		2

Q	Answer	Marks	AO1	AO2	AO3	Total
8dii	**One mark for calculating compression, one for showing as a ratio:** $$Compression\ ratio = \frac{Original\ file\ size}{Compressed\ file\ size}$$ $$Compression\ ratio = \frac{540\ KB}{54\ KB}$$ $$Compression\ ratio = \frac{10\ KB}{1\ KB} = 10:1$$	1 1		1 1		2
9a	**One mark for each:** • The source address • The data itself • Error checking data / checksum	1 1 1	1 1 1			3
9b	**One mark for each correct layer in correct position:** • Layer 5 - Process and application layer • Layer 4 - Transport layer • Layer 3 - Internet layer • Layer 2 - Data link layer • Layer 1 - Physical layer	1 1 1 1 1	1 1 1 1 1			5

Q	Answer	Marks	AO1	AO2	AO3	Total
10ai	**One mark for each:** <table><tr><td>**A**</td><td>**B**</td><td>**$\overline{B}$**</td><td>**$A.B$**</td><td>**$A.\overline{B}$**</td><td>**$B+(A.\overline{B})$**</td></tr><tr><td>1</td><td>1</td><td>**0**</td><td>**1**</td><td>**0**</td><td>**1**</td></tr><tr><td>1</td><td>0</td><td>**1**</td><td>**0**</td><td>**1**</td><td>**1**</td></tr><tr><td>0</td><td>1</td><td>**0**</td><td>**0**</td><td>**0**</td><td>**1**</td></tr><tr><td>0</td><td>0</td><td>**1**</td><td>**0**</td><td>**0**</td><td>**0**</td></tr></table> Marking • $\overline{B}$ correct • $A.B$ correct • $A.\overline{B}$ correct • $B+(A.\overline{B})$ correct	 1 1 1 1		 1 1 1 1		4
10aii	**One mark for correct answer:** $A+B$	1		1		1
10bi	**Three marks for correct answer otherwise one mark for each correct line of working out, up to a maximum of two:** $X=A.B+A.\overline{B}$ $X=A.(B+B)$ $X=A.(1)$ $X=A$	 1 1 1		 1 1 1		3
10bii	**One mark for each correct row (table can contain more or fewer columns)** <table><tr><td>**A**</td><td>**B**</td><td>**$A.B$**</td><td>**$\overline{B}$**</td><td>**$A.\overline{B}$**</td><td>**$A.B+A.\overline{B}$**</td></tr><tr><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr></table>	 1 1 1 1		 1 1 1 1		4

Q	Answer	Marks	AO1	AO2	AO3	Total
11	**Banded mark scheme** Indicative content • A DNS server will contain a list of domain names • A DNS server will contain a list of corresponding IP addresses • A web site address is typed into the address bar of a browser • The browser checks the local (cached) host file to check if it already holds the IP address • The local (your domain) DNS server is queried for the IP address • If the local DNS server does not hold the IP address then the query is passed to another DNS server at a higher level until the IP address is resolved • The address is passed on to DNS severs lower in the hierarchy • When the full address has been resolved, the IP address is then passed to your browser • The browser then connects to the IP address of the server and downloads the web site.	6	6			6

Band	AO1 (Max 6 marks)
2	**4 - 6 marks** The candidate has: • shown clear understanding of the requirements of the question and a clear knowledge of the indicative content. Clear knowledge is defined as a response that provides four to six relevant detailed points from the indicative content • addressed the question appropriately explaining how a domain name is used to access a web site including the role of Domain Name System (DNS) servers with minimal repetition and no irrelevant material • used appropriate technical terminology referring to the indicative content accurately.
1	**1 - 3 marks** The candidate has: • attempted to address the question and has demonstrated some knowledge of the topic specified in the indicative content. Some knowledge is defined as a response that provides one to three relevant points from the indicative content • addressed the question explaining how a domain name is used to access a web site including the role of Domain Name System (DNS) servers • used limited technical terminology referring to the indicative content.
0	**0 marks** Response not credit worthy or not attempted.

Q	Answer	Marks	AO1	AO2	AO3	Total
12	**Banded mark scheme** **Indicative content** Dangers • Hacking - gain unauthorised access to data/to a computer system. • Virus - a program which is capable of copying itself and typically has a detrimental effect, such as corrupting the system or destroying data. • Trojan - a program designed to breach the security of a computer system while ostensibly performing some innocuous function. • Worm - a standalone malware computer program that replicates itself in order to spread to other computers. • Spyware - software that enables a user to obtain information about another's computer activities by transmitting data from their hard drive. • Botnets - a network of private computers infected with malicious software and controlled as a group without the owners' knowledge, e.g. to send spam. • Malware - software which is specifically designed to disrupt or damage a computer system. • Keylogger - a computer program that records every keystroke made by a computer user, especially in order to gain fraudulent access to passwords and other confidential information. • Malicious damage - when a person intentionally sets out to corrupt or delete electronic files, data or software programs. • Accidental damage - when a person unintentionally corrupts or deletes electronic files, data or software programs.	10		10		10

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Q	Answer	Marks	AO1	AO2	AO3	Total
12 (cont.)	<u>Preventions</u> • Unique username and a strong secure password - the organisation limits access to the network by ensuring that all authorised users have unique username and a strong secure password. • Access rights - access to confidential files on the network is limited to authorised users only by assigning access rights to users that only allow certain users to access specified area of the network and/or specified files. • Encryption - hackers are prevented from reading the confidential files even they gain access to it by encrypting the files • Encryption – an encryption key is used and known only by the organisation • Firewall - the servers would be protected with firewall software blocking / checking all network traffic entering or leaving specified ports / stop programs accessing the internet • Antivirus software - file servers would be protected with antivirus software which regularly scans all files stored on them for possible infection by malware • Antivirus software - email server would be protected with antivirus software and all incoming emails would be scanned to see if attached files are infected • Antivirus software - workstations would be protected with antivirus software and all files from external media would be scanned before they're allowed to be accessed • Accounting or auditing software – all files accessed by a user are recorded in an activity log					

Band	AO2 (Max 10 marks)					
3	**8 - 10 marks** The candidate has: • shown clear understanding of the requirements of the question and a clear knowledge of the indicative content. Clear knowledge is defined as a response that provides eight to ten relevant detailed points from the indicative content relating to **both** the dangers and the importance of network security with suitable security preventions, with a maximum of 5 marks for either aspect • addressed the question appropriately describing methods that the organisation can use to protect its data • produced writing which is very well structured using accurate grammar, punctuation and spelling • used appropriate technical terminology referring to the indicative content accurately					
2	**4 - 7 marks** The candidate has: • shown adequate understanding of the requirements of the question and a satisfactory knowledge of the indicative content. Satisfactory knowledge is defined as a response that provides four to seven points from the indicative content relating to **both** the dangers and the importance of network security with suitable security preventions, with a maximum of 5 marks for either aspect • addressed the question describing methods that the organisation can use to protect its data • produced writing which is generally well structured using reasonably accurate grammar, punctuation and spelling • used appropriate technical terminology referring to the indicative content					
1	**1 - 3 marks** The candidate has: • attempted to address the question but has demonstrated superficial knowledge of the indicative content. Superficial knowledge is defined as a response that provides one to three points from the indicative content relating to the dangers **and/or** the importance of network security with suitable security preventions • produced writing which shows some evidence of structure but with some errors in grammar, punctuation and spelling • used limited technical terminology referring to the indicative content					
0	**0 marks** Response not credit worthy or not attempted.					
	TOTAL	100	52	48	0	100