Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

COMPUTER SCIENCE **9608/32**

Paper 3 Written Paper **October/November 2019**

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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This document consists of **8** printed pages.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>1 mark per correct row
<table>
<tr><th></th><th>Description</th><th>Term</th></tr>
<tr><td>A</td><td>The original data to be transmitted as a message</td><td>Plain text</td></tr>
<tr><td>B</td><td>An electronic document from a trusted authority that ensures authentication</td><td><u>Digital</u> certificate</td></tr>
<tr><td>C</td><td>An encryption method produced by a trusted authority that can be used by anyone</td><td>Public key</td></tr>
</table></td><td>3</td></tr>
<tr><td>1(b)(i)</td><td>1 mark per bullet point to max 2
• To ensure a document is authentic // came from a trusted source
• To ensure a document has not been altered during transmission
• Non repudiation</td><td>2</td></tr>
<tr><td>1(b)(ii)</td><td>1 mark per bullet point to max 3
• The message is hashed with the agreed hashing algorithm …
• … to produce a message digest
• The message digest is encrypted with the <u>sender’s</u> private key…
• … so the digital signature can be decrypted with <u>sender’s</u> public key</td><td>3</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>1 mark for each 2 correct products, i.e. 3 marks for 6, 2 marks for 4 or 5, 1 mark for 2 or 3

$\mathbf{X} = \overline{\mathbf{A}}.\overline{\boldsymbol{B}}.\overline{\boldsymbol{C}} + \overline{\boldsymbol{A}}.\overline{\mathbf{B}}.\mathbf{C} + \overline{\mathbf{A}}.\mathbf{B}.\overline{\boldsymbol{C}} + \overline{\boldsymbol{A}}.\mathbf{B}.\mathbf{C} + \mathbf{A}.\overline{\boldsymbol{B}}.\overline{\boldsymbol{C}} + \boldsymbol{A}.\overline{\boldsymbol{B}}.\mathbf{C}$</td><td>3</td></tr>
<tr><td>2(a)(ii)</td><td>1 mark for the correct K-map
AB
C
<table><tr><th></th><th>00</th><th>01</th><th>11</th><th>10</th></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr></table></td><td>1</td></tr>
<tr><td>2(a)(iii)</td><td>1 mark for each correct loop
AB
C
<table><tr><th></th><th>00</th><th>01</th><th>11</th><th>10</th></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td></tr></table></td><td>2</td></tr>
<tr><td>2(a)(iv)</td><td>1 mark per bullet point:

• $\overline{\mathbf{A}}$
• + $\overline{\mathbf{B}}$

$\mathbf{X} = \overline{\mathbf{A}} + \overline{\mathbf{B}}$ // $\mathbf{X} = \overline{\mathbf{B}} + \overline{\mathbf{A}}$</td><td>2</td></tr>
<tr><td>2(b)</td><td>$\mathbf{X} = \left(\overline{(\overline{\mathbf{W}} + \mathbf{X}).(\mathbf{Y} + \overline{\mathbf{Z}})}\right)$

One mark for correct use of <u>De Morgan's law</u> to +
• $\mathbf{X} = \overline{(\overline{\mathbf{W}} + \mathbf{X})} + \overline{(\mathbf{Y} + \overline{\mathbf{Z}})}$

One mark for correct use of <u>De Morgan's law</u> + to
• $\mathbf{X} = \overline{\overline{\mathbf{W}}}.\overline{\mathbf{X}} + \overline{\mathbf{Y}}.\overline{\overline{\mathbf{Z}}}$

One mark for correct answer
• $\mathbf{X} = \mathbf{W}.\overline{\mathbf{X}} + \overline{\mathbf{Y}}.\mathbf{Z}$</td><td>3</td></tr>
</table>

Question	Answer	Marks
3(a)	1 mark per appropriate term: Computer 1 and Computer 2 are on the same bus network. Computer 1 sends a message to Computer 2. Before the message is sent, it is split into **packets**. Computer 1 needs to check that the **line / path / bus / channel** is free before sending the message, otherwise a **collision** will occur that will be managed by the **CSMA/CD** protocol.	**4**
3(b)	1 mark per bullet point, **max 2** marks per device: **Router** • Contains a routing table • … holds the (private) IP / MAC addresses of the devices on the bus • provides the public IP address for the network • forwards packets to the correct IP / MAC address • may contain a firewall / proxy server **NIC** • Has a (unique) MAC address • … to identify a device • Provides a hardware interface // physical connection between computer and network // connection to Ethernet cable	**4**
3(c)(i)	1 mark per bullet point to **max 2** • Wireless Access Points // WAP • Wireless Network Interface Card // WNIC // Wireless adapter • Wireless Router • (Wireless) Repeater	**2**
3(c)(ii)	1 mark per bullet point to **max 4** Send **(max 3 marks)** • Encrypts the data (using TKIP or AES) • … encodes the data into radio / analogue signal • Listens for other radio signals • Transmits / broadcasts **when quiet** • … using an antenna / WNIC / WAP / aerial Receive (**max 3 marks**) • (Constantly) checking / tuning into / detecting signals • Receives radio / analogue signal • … using an antenna / WNIC / WAP / aerial • Checks if the signal is for that device • If so, decodes the signal • … and decrypts the data	**4**

Question	Answer	Marks
4(a)	1 mark per bullet point to **max 2** • Disk / secondary storage is used to extend the RAM / memory available • … so CPU can access more memory space than available RAM • Only part of program / data in use needs to be in RAM • Data is swapped between RAM and disk	**2**
4(b)(i)	1 mark per bullet point to **max 4** • Divide memory / RAM into frames • Divide virtual memory into blocks of same size called pages • Frames / pages are a fixed size • Set up a page table to translate logical to physical addresses • Keep track of all free frames • Swap pages in memory with new pages from disk when needed	**4**
4(b)(ii)	First-in-first-out // least-recently-used page // least-used-page	**1**
4(b)(iii)	1 mark per bullet point to **max 2** • Pages are required back in RAM as soon as they are moved to disk • There is **continuous** swapping (of the same pages) • No useful processing happens // deadlock • … (because) pages that are in RAM and on disk are inter-dependent • … (nearly) all processing time is used for swapping pages	**2**

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Question	Answer	Marks
5(a)	1 mark per bullet point to **max 2** • Monitoring only gathers information but control systems also perform actions • Output in a control system can affect the input • There is no feedback in a monitoring system // a control system relies on feedback • Example of monitoring applied to the weather station	**2**
5(b)(i)	1 mark per bullet point to **max 2** • So the readings are stored in **chronological** order • Easy to add / append each new reading to the end of the file // no further processing is required • Allows the readings to be read in the order that they were taken • Readings do not need to be given further identification as to date / time // no key field needs to be added	**2**
5(b)(ii)	1 mark per bullet point **max 2** • Earliest temperature reading is accessed first • and each successive temperature reading is read (in date / time order) • until the final reading has been accessed	**2**
5(b)(iii)	1 mark for Random 1 mark per bullet point for description to **max 3** • Record locations are calculated • … using a hashing algorithm **on a key field** • If a record cannot be stored / found at that location • … then subsequent locations are searched // closed hash • ... or an overflow area is searched // open hash	**4**

Question	Answer	Marks
6(a)	1 mark per bullet point to **max 2** • Derived from one or more existing data types • Used to extend the built-in data types • Creates data-types specific to applications // programmer's requirements	**2**
6(b)(i)	Enumerated (data type)	**1**
6(b)(ii)	`DECLARE CurrentMonth : Months`	**1**
6(b)(iii)	`CurrentMonth ← August`	**1**

Question	Answer	Marks
7(a)(i)	1 mark for each bullet point to **max 2** Keyword table: • The reserved words used • The operators used • Their matching tokens	**2**
7(a)(ii)	1 mark for each bullet point to **max 2** Symbol table: • Identifier name used • … the (data) type • … role, e.g. variable, constant, array, procedure / scope • Location (marker) // value of constant	**2**
7(a)(iii)	1 mark per bullet point to **max 2** • Keywords / operators are looked up (in the keyword table) • Keywords / operators are represented by tokens • Identifiers are looked up in (the symbol table) • Identifiers are converted to locations / addresses • Used to create a sequence of tokens (for the program)	**2**
7(a)(iv)	The white space removed // redundant characters are removed // removal of comments // identification of errors	**1**
7(b)	1 mark per bullet point to **max 2** • Redundant code removed // fewer instructions required • Program requires less memory / storage space • Code reorganised to make it more efficient • Program will complete task in a shorter time	**2**

Question	Answer	Marks
8(a)(i)	1101	**1**
8(a)(ii)	011100000000	**1**
8(a)(iii)	1 mark for positive, 1 for justification • Positive … • … the most significant / first bit in the mantissa is 0	**2**
8(a)(iv)	1 mark per bullet point • Exponent = 1011 = −3 // binary point moved 3 places left • Mantissa 0.111 becomes 0.000111 // ⅞ // ½ + ¼ + ⅛ // $2^{-1} + 2^{-2} + 2^{-3}$ • Answer: 7 / 64 // 0.109375	**3**
8(b)	1 mark per bullet point • Increases the range • Decreases the precision	**2**