Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

COMPUTER SCIENCE **9608/31**

Paper 3 Written Paper **May/June 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.

Cambridge International is publishing the mark schemes for the May/June 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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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).

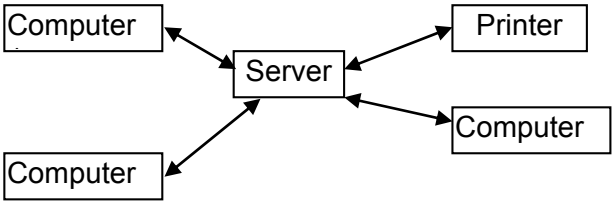
GENERIC MARKING PRINCIPLE 6:

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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Question	Answer	Marks
1(a)	**2 marks** for working shown **1 mark** for the correct answer Working: • Correct calculation of negative value (any method) (= –0.11010001101) • Correctly moving the binary point 7 places (= –01101000.1101) // Exponent 7 Answer: • −104.8125 // $-104\frac{13}{16}$	**3**
1(b)	**2 marks** for working shown **1 mark** for the correct answer Working: • Correct conversion to binary (01.1001) • Correct calculation of exponent (1) Answer: • (Mantissa) 0110 0100 0000 (Exponent) 0001	**3**
1(c)(i)	**1 mark** per bullet point • Mantissa = 0111 1111 1111 • Exponent = 0111	**2**
1(c)(ii)	**1 mark** per bullet point • Mantissa = 0100 0000 0000 • Exponent = 1000	**2**
1(d)	**1 mark** per bullet point to **max 3** • The trade-off is between range and precision • Any increase in the number of bits for the mantissa, means fewer bits available for the exponent // Any decrease in the number of bits for the mantissa, means more bits available for the exponent • More bits used for the mantissa will result in better precision • More bits used for the exponent will result in a larger range of numbers • Fewer bits used for the mantissa will result in worse precision • Fewer bits used for the exponent will result in a smaller range of numbers	**3**

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Question	Answer	Marks
2(a)(i)	**1 mark** per bullet point Diagram shows: • All four devices labelled and connected directly to the server • And no other device • Two-way flow of data between each device and the server  	**3**
2(a)(ii)	**1 mark** per benefit and **1 mark** for a further explanation in context to **max 2 (x2)** For example: • Personal data (used by admissions department) is kept secure • … transmissions only go between server and destination • A new device/employee can be easily added to the network • …only one connection direct to server needs setting up • If one node or link fails • … the other employees can continue working / the rest of network is unaffected • If the department has a range of different devices • … they can all operate at different speeds or with different protocols	**4**
2(b)	**1 mark** per bullet point (**max 3**) • Carrier Sense Multiple Access (with) Collision Detection • Before transmitting a device checks if the channel is busy • If it is busy the device waits // if channel free data is sent • When transmission begins the device listens for other devices also beginning transmission • If there is a collision, transmission is aborted / transmitting a jam signal • Both devices wait a (different) random time, then try again	**3**
2(c)(i)	**1 mark** per bullet point (**max 2**) • Allows (internal) connections between the university LANs • Allows external connection from the main LAN	**2**
2(c)(ii)	**1 mark** per bullet point (**max 2**) • Provides device with a MAC address • …to uniquely identify it on the network • Allows each individual device to connect to the network	**2**
2(c)(iii)	**1 mark** per bullet (**max 2**) • Allowing devices to connect to the LAN via radio communication • … instead of using a cable • … easy to move a device to as different location	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)</td><td>NOR</td><td>1</td></tr>
<tr><td>3(b)(i)</td><td>1 mark for X column, 1 mark for Y column
<table>
<tr><th>A</th><th>B</th><th>Working Space</th><th>X</th><th>Y</th></tr>
<tr><td>0</td><td>0</td><td></td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td></td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td></td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td></td><td>1</td><td>0</td></tr>
</table></td><td>2</td></tr>
<tr><td>3(b)(ii)</td><td>Half adder</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>1 mark per bullet
• X is (used for) <u>carry</u>
• Y is (used for) <u>sum</u></td><td>2</td></tr>
<tr><td>3(c)</td><td>1 mark per bullet for working (max 4)

$\bar{A}.\bar{B}.\bar{C}.\bar{D} + \bar{A}.\bar{B}.\bar{C}.D + \bar{A}.\bar{B}.C.D + \bar{A}.B.\bar{C}.\bar{D} + \bar{A}.B.\bar{C}.\bar{D}$
$= \bar{A}.\bar{B}.\bar{C}.\bar{D} + \bar{A}.\bar{B}.\bar{C}.D + \bar{A}.\bar{B}.C.D + \bar{A}.B.\bar{C}.\bar{D} + \bar{A}.B.\bar{C}.\bar{D} + \bar{A}.\bar{B}.\bar{C}.\bar{D}$
• Adding in a second copy of the first term (Use of Idempotent Law)

$= \bar{A}.\bar{B}.\left(\bar{C}.\bar{D} + \bar{C}.D + C.D + C.\bar{D}\right) + \bar{A}.\bar{C}.\bar{D}.\left(B + \bar{B}\right)$
• Taking $\bar{A}.\bar{B}$ and $\bar{A}.\bar{C}.\bar{D}$ outside brackets (Associative Law)

$= \bar{A}.\bar{B}.\left(\bar{C}.\left(\bar{D} + D\right) + C.\left(D + \bar{D}\right)\right) + \bar{A}.\bar{C}.\bar{D}.\left(B + \bar{B}\right)$
• Grouping $\bar{C}.\left(\bar{D} + D\right) + C.\left(D + \bar{D}\right)$ (Associative Law and Commutative Law)

$= \bar{A}.\bar{B}.\left(\bar{C}.(1) + C.(1)\right) + \bar{A}.\bar{C}.\bar{D}.(1)$
$= \bar{A}.\bar{B}.\left(\bar{C} + C\right) + \bar{A}.\bar{C}.\bar{D}.(1)$
$= \bar{A}.\bar{B}.(1) + \bar{A}.\bar{C}.\bar{D}.(1)$
• Replacing $\left(D + \bar{D}\right)$ with 1 and replacing $\left(\bar{C} + C\right)$ with 1 (Use of Complement Law)

$= \bar{A}.\bar{B} + \bar{A}.\bar{C}.\bar{D}$
• Reducing first four terms to $\bar{A}.\bar{B}$ and reducing last two terms to $\bar{A}.\bar{C}.\bar{D}$ (Use of Identity Law)

1 mark for correct answer
$= \bar{A}.(\bar{B} + \bar{C}.\bar{D})$</td><td>5</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>1 mark for 2 correct rows, 2 marks for 3 correct rows, 3 marks for 4 correct rows
<table>
<tr><th rowspan="2">Symbol</th><th colspan="2">Token</th></tr>
<tr><th>Value</th><th>Type</th></tr>
<tr><td>Counter</td><td>60</td><td>Variable</td></tr>
<tr><td>0</td><td>61</td><td>Constant</td></tr>
<tr><td>Password</td><td>62</td><td>Variable</td></tr>
<tr><td>"Cambridge"</td><td>63</td><td>Constant</td></tr>
<tr><td>1</td><td>64</td><td>Constant</td></tr>
</table></td><td>3</td></tr>
<tr><td>4(b)</td><td>
<table><tr><td>60</td><td>01</td></tr></table> First two cells given in question.

1 mark for next 3 cells

<table><tr><td>61</td><td>51</td><td>62</td></tr></table>
1 mark for the remainder

<table><tr><td>4E</td><td>4A</td><td>62</td><td>04</td><td>63</td><td>4B</td><td>51</td><td>62</td><td>4C</td><td>60</td></tr></table> ....

.... <table><tr><td>01</td><td>60</td><td>02</td><td>64</td><td>4F</td><td>62</td><td>03</td><td>63</td><td>52</td><td>60</td></tr></table>
</td><td>2</td></tr>
<tr><td>4(c)(i)</td><td>1 mark per bullet point
• Removing the fourth line (LDD 238) …
• Changing operand for second ADD from 236 to 238 …
• … First three lines and last line unchanged

<pre>LDD 236
ADD 237
STO 236
ADD 238
STO 238</pre></td><td>3</td></tr>
<tr><td>4(c)((ii)</td><td>1 mark per bullet point (max 2)
• Optimisation means that the code will have fewer instructions
• Optimised code occupies less space in memory
• Fewer instructions reduces the execution time of the program</td><td>2</td></tr>
</table>

Question	Answer	Marks
5(a)	**1 mark** per bullet point • Keys • Cipher text • Manager's public and private keys in correct spaces • Wiktor's public and private keys in correct spaces • Plain text Asymmetric encryption uses different **keys** for encrypting and decrypting data. When Wiktor sends a message to his manager, the message is encrypted into **cipher text** using his manager's **public** key. When the manager receives the message, it is decrypted using her **private** key. When the manager replies, the message is encrypted using Wiktor's **public** key, and when Wiktor receives the message, it is decrypted into **plain text** using his **private** key.	**5**
5(b)	**1 mark** per bullet point (**max 6**) • Browser requests that the server identifies itself • Server sends a copy of its (Digital) Certificate • … containing its public key • Browser checks the certificate • …against a list of trusted Certificate Authorities • If the browser trusts the certificate • … a symmetric session key is created • …this is (by the browser) encrypted using the server's public key and sent to the server • Server decrypts the symmetric session key • … using its private key • Server and browser now encrypt all transmitted data with the session key	**6**
5(c)	**1 mark** for type of malware and **1 mark** for prevention, **max 2 (x 2)** For example: • Virus • Have company policies to ensure that anti-virus software is installed, regularly updated and run • Spyware • Have company policies to ensure that anti-spyware software is installed, regularly updated and run • Phishing • Have network policies to ensure that the firewall criteria include SPAM filters, whitelist, blacklist etc.	**4**

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Question	Answer	Marks
6(a)	**1 mark** per bullet point (**max 3**) • To ensure that the system operates within the given criteria • By enabling system output to affect subsequent system inputs • Thus enabling the system to automatically adjust conditions • Suitable example of feedback	**3**
6(b)	**1 mark** per bullet point • Sensors continually measure the temperature of the water in the swimming pool • The (stream of) readings are sent to a processor and compared with 28 degrees • If the reading is out of range (by a system set amount) then actuators turn the heater/cooler on or off as necessary • Feedback ensures that the water temperature remains close to 28 degrees	**4**
6(c)	**1 mark** for example of monitoring system, **max 2** for explanation • Suitable example identified • Use of data captured • No feedback as there is no output that could change the system environment For example: • Monitoring the rainfall • The amount of rainfall collected over a specific time is measured • There is no output to change the level of rainfall **or** • Security camera • Sending pictures to control room • No changes made to environment by system	**3**