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**COMPUTER SCIENCE**

**9608/31**

Paper 3 Written Paper

**May/June 2018**

MARK SCHEME

Maximum Mark: 75

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**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 2018 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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This document consists of **8** printed pages.

### 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.

Question	Answer	Marks
1(a)	<p><b>1 mark per bullet max 2</b></p> <ul style="list-style-type: none"> <li>• 0101 = 5 (conversion of exponent to denary)</li> <li>• 1.01110011010 = -0.10001100110 (conversion of mantissa to negative binary number)</li> <li>• -10001.100110 (binary value)// -0.54980469 (denary value of mantissa) // -563/1024</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Use exponent to denormalise mantissa</li> </ul> <p><b>1 mark for correct answer</b></p> <ul style="list-style-type: none"> <li>• = -17 19/32 // -17.59375</li> </ul>	<b>3</b>
1(b)	<p><b>1 mark per bullet</b></p> <ul style="list-style-type: none"> <li>• 5.25 = 101.01 (conversion to binary)</li> <li>• = 0.10101 × 2<sup>3</sup> (evidence of shifting binary point appropriately)</li> <li>• 010101000000 0011 (stored as mantissa and exponent)</li> </ul>	<b>3</b>
1(c)	<p><b>1 mark per bullet</b></p> <ul style="list-style-type: none"> <li>• (Size of mantissa decreased means that) precision is reduced</li> <li>• (Size of exponent is increased means that) range is increased</li> </ul>	<b>2</b>

Question	Answer	Marks
2(a)	<u>single data type</u> that does not involve a reference to another type/usually built in to a programming language	<b>1</b>
2(b)	<p><b>1 mark for data type, 1 for definition, max 4, 2 data types</b></p> <ul style="list-style-type: none"> <li>• Integer</li> <li>• Stores a whole number</li> <li>• Boolean</li> <li>• Stores true or false/1 or 0/on or off</li> <li>• Real/Single/Double/Float/Decimal</li> <li>• Stores decimal numbers</li> <li>• String</li> <li>• Stores zero or more characters</li> <li>• Char</li> <li>• Stores a single character</li> <li>• Pointer</li> <li>• Whole number used to reference a memory location</li> </ul>	<b>4</b>
2(c)	data type constructed from other data types	<b>1</b>

Question	Answer	Marks
2(d)	<p><b>1</b> mark for naming, <b>1</b> for description, max <b>4</b>, 2 data types</p> <ul style="list-style-type: none"> <li>• Record</li> <li>• collection of related items which may have different data types</li> <li>• Array</li> <li>• (Indexed) collection of items with the same data type</li> <li>• List</li> <li>• (Indexed) collection of items that can have different data types</li> <li>• Set</li> <li>• stores a finite number of different values that have no order // supports mathematical operations</li> <li>• Class/Structure</li> <li>• Gives the properties and methods for an object</li> </ul>	<b>4</b>

Question	Answer	Marks
3(a)(i)	<p><b>1</b> mark per bullet, max <b>1</b> benefit, max <b>1</b> drawback</p> <p>Benefits</p> <ul style="list-style-type: none"> <li>• Signals only go to destination//secure</li> <li>• Easy to connect/remove nodes or devices/trouble shoot.</li> <li>• Centralised management helps in monitoring the network.</li> <li>• Failure of one node or link doesn't affect the rest of network.</li> <li>• Performance does not degenerate under load</li> <li>• Connections may use different protocols</li> <li>• Fewer collisions</li> </ul> <p>Drawbacks</p> <ul style="list-style-type: none"> <li>• If central device fails then whole network goes down.</li> <li>• Performance is dependent on capacity of central device.</li> </ul>	<b>2</b>
3(a)(ii)	<p><b>1</b> mark per bullet, max <b>1</b> benefit, max <b>1</b> drawback</p> <p>Benefits</p> <ul style="list-style-type: none"> <li>• Easier to set-up/extend.</li> <li>• Less cable required</li> </ul> <p>Drawbacks</p> <ul style="list-style-type: none"> <li>• If the main cable breaks, network performance badly degraded.</li> <li>• Difficult to detect and troubleshoot fault at an individual station.</li> <li>• Efficiency reduces as the number of devices connected to it increases.</li> <li>• Collisions // not suitable for networks with heavy traffic.</li> <li>• Security is lower (because several computers receive the sent signal from the source.)</li> </ul>	<b>2</b>

Question	Answer	Marks														
3(b)	<p>1 mark for each correct pair of letters in the right order max 3</p> <table border="1" data-bbox="316 297 1313 685"> <tr> <td data-bbox="316 297 368 349">1</td> <td data-bbox="368 297 1313 349">Computer X sends a connection request to Computer Y.</td> </tr> <tr> <td data-bbox="316 349 368 400">2</td> <td data-bbox="368 349 1313 400">Computer Y sends ready or busy signal.</td> </tr> <tr> <td data-bbox="316 400 368 483">3</td> <td data-bbox="368 400 1313 483">If busy, Computer X waits and then resends the connection request to Computer Y.</td> </tr> <tr> <td data-bbox="316 483 368 535">4</td> <td data-bbox="368 483 1313 535"><b>D</b></td> </tr> <tr> <td data-bbox="316 535 368 586">5</td> <td data-bbox="368 535 1313 586"><b>A</b></td> </tr> <tr> <td data-bbox="316 586 368 638">6</td> <td data-bbox="368 586 1313 638"><b>C</b></td> </tr> <tr> <td data-bbox="316 638 368 689">7</td> <td data-bbox="368 638 1313 689"><b>B</b></td> </tr> </table>	1	Computer X sends a connection request to Computer Y.	2	Computer Y sends ready or busy signal.	3	If busy, Computer X waits and then resends the connection request to Computer Y.	4	<b>D</b>	5	<b>A</b>	6	<b>C</b>	7	<b>B</b>	<b>3</b>
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3(c)(i)	<p>1 mark for each layer</p> <table border="1" data-bbox="539 781 1090 985"> <thead> <tr> <th data-bbox="539 781 804 833">Protocol</th> <th data-bbox="804 781 1090 833">Layer</th> </tr> </thead> <tbody> <tr> <td data-bbox="539 833 804 884"><b>TCP</b></td> <td data-bbox="804 833 1090 884">Transport</td> </tr> <tr> <td data-bbox="539 884 804 936"><b>IP</b></td> <td data-bbox="804 884 1090 936">Internet/Network</td> </tr> <tr> <td data-bbox="539 936 804 985"><b>SMTP</b></td> <td data-bbox="804 936 1090 985">Application</td> </tr> </tbody> </table>	Protocol	Layer	<b>TCP</b>	Transport	<b>IP</b>	Internet/Network	<b>SMTP</b>	Application	<b>3</b>						
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3(c)(ii)	<p>Any <b>three</b> points from:</p> <ul data-bbox="375 1070 1313 1585" style="list-style-type: none"> <li>• BitTorrent client software made available</li> <li>• One computer must keep a complete copy of the torrent/file to be shared</li> <li>• Torrent/file is split into small pieces</li> <li>• A computer joins (a swarm) by using the BitTorrent software to load a torrent descriptor file</li> <li>• The computer can now download a piece of the file</li> <li>• Once a computer has a piece it can become a seed and upload (to other members of the swarm)</li> <li>• Pieces of the torrent are both downloaded and uploaded (by each member of the of the swarm)</li> <li>• A server called a tracker keeps records of all the computers in the swarm</li> <li>• The tracker shares their IP addresses allowing them to connect to each other</li> </ul>	<b>3</b>														

Question	Answer	Marks																																	
4(a)(i)	2 marks all products correct, 1 mark 2 or 3 products correct $X = \bar{A}.B.\bar{C} + \bar{A}.B.C + A.B.\bar{C} + A.B.C$	2																																	
4(a)(ii)	1 mark for all correct bits  <div style="text-align: center;"> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2"></td> <td colspan="4" style="text-align: center;"><b>AB</b></td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center;">00</td> <td style="text-align: center;">01</td> <td style="text-align: center;">11</td> <td style="text-align: center;">10</td> </tr> <tr> <td rowspan="2" style="vertical-align: middle; padding-right: 10px;"><b>C</b></td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> </tr> </table> </div>			<b>AB</b>						00	01	11	10	<b>C</b>	0	0	1	0	1	1	0	1	0	1	1										
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4(a)(iv)	1 mark per bullet – allow follow through from 4(a)(iii) <ul style="list-style-type: none"> <li>• <math>\bar{A}.B</math></li> <li>• <math>+A.\bar{B}</math></li> </ul> $X = \bar{A}.B + A.\bar{B}$	2																																	
4(b)(i)	1 mark per bullet max 2 <ul style="list-style-type: none"> <li>• Correct column headings and row headings – values only</li> <li>• Correct column headings and row headings – order</li> </ul> 1 mark for 2 correct rows/columns, 2 marks for 4 correct rows/columns (based on headings) max 2  <div style="text-align: center;"> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="2"></td> <td colspan="4" style="text-align: center;"><b>AB</b></td> </tr> <tr> <td colspan="2"></td> <td style="text-align: center;">00</td> <td style="text-align: center;">01</td> <td style="text-align: center;">11</td> <td style="text-align: center;">10</td> </tr> <tr> <td rowspan="4" style="vertical-align: middle; padding-right: 10px;"><b>CD</b></td> <td style="text-align: center;"><b>00</b></td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;"><b>01</b></td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;"><b>11</b></td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;"><b>10</b></td> <td style="text-align: center;">0</td> <td style="text-align: center;">1</td> <td style="text-align: center;">0</td> <td style="text-align: center;">0</td> </tr> </table> </div>			<b>AB</b>						00	01	11	10	<b>CD</b>	<b>00</b>	0	1	1	0	<b>01</b>	0	1	1	0	<b>11</b>	0	1	0	0	<b>10</b>	0	1	0	0	4
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4(b)(iii)	1 mark per bullet $\bar{A}.B$ $+B.\bar{C}$ $X = \bar{A}.B + B.\bar{C}$	2																																	

Question	Answer	Marks
5(a)(i)	c4 is not a <u>signed</u> integer	1
5(a)(ii)	10 is not a valid <u>signed</u> integer // 0 is not a valid digit/signed integer // only one digit allowed	1
5(a)(iii)	wrong assignment operator // should be = not := // 6 is not a valid digit/signed integer	1
5(b)	1 mark per bullet assignment <ul style="list-style-type: none"> <li>• <code>&lt;variable&gt;=&lt;variable&gt;&lt;operator&gt;&lt;signed integer&gt;</code></li> </ul> variable <ul style="list-style-type: none"> <li>• <code>&lt;letter&gt;&lt;letter&gt;</code></li> </ul> signed integer <ul style="list-style-type: none"> <li>• <code>+&lt;digit&gt;   -&lt;digit&gt;</code></li> </ul> operator <ul style="list-style-type: none"> <li>• <code>^   \</code></li> </ul> <code>&lt;assignment statement&gt; ::=</code> <code>&lt;variable&gt; = &lt;variable&gt;&lt;operator&gt;&lt;signed integer&gt;</code> <code>&lt;variable&gt; ::= &lt;letter&gt;&lt;letter&gt;</code> <code>&lt;signed integer&gt; ::= +&lt;digit&gt;   -&lt;digit&gt;</code> <code>&lt;operator&gt; ::= ^   \</code>	4
5(c)	1 mark per bullet <ul style="list-style-type: none"> <li>• <code>&lt;letter&gt; </code></li> <li>• <code>&lt;letter&gt;&lt;variable&gt;</code></li> </ul> For example: <code>&lt;letter&gt; &lt;letter&gt;&lt;variable&gt;</code> <code>&lt;letter&gt; &lt;variable&gt;&lt;letter&gt;</code>	2

Question	Answer	Marks										
6(a)(i)	1 mark for each term or description <table border="1" data-bbox="316 1496 1315 1951"> <thead> <tr> <th>Description</th> <th>Term</th> </tr> </thead> <tbody> <tr> <td>Redirection to a bogus website that appears to be legitimate to gain confidential data</td> <td>Pharming</td> </tr> <tr> <td>Use email to attempt to gain a user's confidential data</td> <td>Phishing</td> </tr> <tr> <td><b>A piece of software that records/stores user actions/keystrokes <u>without the user's knowledge</u> and sends them to a third party for analysis</b></td> <td>Spyware</td> </tr> <tr> <td><b>A standalone piece of malicious software that replicates itself</b></td> <td>Worm</td> </tr> </tbody> </table>	Description	Term	Redirection to a bogus website that appears to be legitimate to gain confidential data	Pharming	Use email to attempt to gain a user's confidential data	Phishing	<b>A piece of software that records/stores user actions/keystrokes <u>without the user's knowledge</u> and sends them to a third party for analysis</b>	Spyware	<b>A standalone piece of malicious software that replicates itself</b>	Worm	4
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Question	Answer	Marks
6(a)(ii)	<p><b>1</b> mark for pharming solution, <b>1</b> for phishing Allow follow through from <b>(a)(i)</b></p> <p>Pharming</p> <ul style="list-style-type: none"> <li>Use a reliable ISP //check URL is spelt correctly // check that http has changed to https //security software installed and kept updated // only accept valid public key certificates // check that links are genuine</li> </ul> <p>Phishing</p> <ul style="list-style-type: none"> <li>ignore email // delete email // don't click on links in emails</li> </ul>	<b>2</b>
6(b)	<p><b>1</b> mark per bullet to max <b>4</b></p> <ul style="list-style-type: none"> <li>software is put through a hashing algorithm by the company</li> <li>hash total is encrypted with the company's private key</li> <li>company sends software and encrypted hash</li> <li>customer is in possession of company's public key (from the digital certificate)</li> <li>customer decrypts the received hash with public key</li> <li>customer hashes the received software with the hash algorithm (from the digital certificate)</li> <li>if decrypted hash and the software hash match, the software has come from the company/is authentic and has not been altered.</li> </ul>	<b>4</b>

Question	Answer	Marks																																								
7(a)	control system // monitoring and control system	<b>1</b>																																								
7(b)	<p><b>1</b> mark for identifying hardware, <b>1</b> for purpose to max <b>4</b> for 2 hardware devices</p> <p>For example:</p> <ul style="list-style-type: none"> <li>actuator/relay/switch (1) to turn a heater/fan on or off (1)</li> <li>heater (1) to heat the museum (1)</li> <li>fan (1) to cool the museum (1)</li> <li>analogue to digital converter (1) to convert analogue signal <u>from sensor</u> to a digital value that can be stored/manipulated (1)</li> <li>transmission hardware//cable (1) to transfer data/signals (1)</li> <li>processor (1) to manage the temperature control (1)</li> <li>Visible/audible warning device (1) to give warning to a human if temperature is at a dangerous level (1)</li> </ul>	<b>4</b>																																								
7(c)(i)	<p><b>1</b> mark per bullet</p> <ul style="list-style-type: none"> <li>Temperature reading is 179</li> <li>reading in room 5</li> <li>has been processed</li> </ul>	<b>3</b>																																								
7(c)(ii)	<p><b>1</b> mark for each 8 bits</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> </tr> <tr> <td colspan="8" style="text-align: center;"><b>Byte 1</b></td> </tr> </table> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="border: 1px solid black; padding: 2px;">7</td> <td style="border: 1px solid black; padding: 2px;">6</td> <td style="border: 1px solid black; padding: 2px;">5</td> <td style="border: 1px solid black; padding: 2px;">4</td> <td style="border: 1px solid black; padding: 2px;">3</td> <td style="border: 1px solid black; padding: 2px;">2</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">1</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> <td style="border: 1px solid black; padding: 2px;">0</td> </tr> <tr> <td colspan="8" style="text-align: center;"><b>Byte 2</b></td> </tr> </table>	1	1	1	0	1	1	1	0	<b>Byte 1</b>								7	6	5	4	3	2	1	0	0	0	0	1	0	0	0	0	<b>Byte 2</b>								<b>2</b>
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