
COMPUTER SCIENCE

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Paper 3 Written Paper

October/November 2017

MARK SCHEME

Maximum Mark: 75

Published

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This document consists of **12** printed pages.

Question	Answer	Marks																				
1(a)	<p>Each device has a single connection to the bus (1)</p> <p>One terminator at each end (1)</p> <p>The terminators do not need to be labelled as long as they are obvious</p>	2																				
1(b)	<table border="1"> <thead> <tr> <th data-bbox="308 786 1031 835">Statement</th> <th data-bbox="1031 786 1142 835">True</th> <th data-bbox="1142 786 1257 835">False</th> <th data-bbox="1257 786 1321 835"></th> </tr> </thead> <tbody> <tr> <td data-bbox="308 835 1031 920">The server can send packets to Computer B and the router at the same time.</td> <td data-bbox="1031 835 1142 920"></td> <td data-bbox="1142 835 1257 920">✓</td> <td data-bbox="1257 835 1321 920">(1)</td> </tr> <tr> <td data-bbox="308 920 1031 1005">Computer C uses the IP address of a web server to send a request for a web page on the web server</td> <td data-bbox="1031 920 1142 1005">✓</td> <td data-bbox="1142 920 1257 1005"></td> <td data-bbox="1257 920 1321 1005">(1)</td> </tr> <tr> <td data-bbox="308 1005 1031 1090">Computer B can read a packet sent from Computer A to Computer C.</td> <td data-bbox="1031 1005 1142 1090">✓</td> <td data-bbox="1142 1005 1257 1090"></td> <td data-bbox="1257 1005 1321 1090">(1)</td> </tr> <tr> <td data-bbox="308 1090 1031 1176">The server can read all incoming packets from the Internet.</td> <td data-bbox="1031 1090 1142 1176">✓</td> <td data-bbox="1142 1090 1257 1176">✓</td> <td data-bbox="1257 1090 1321 1176">(1)</td> </tr> </tbody> </table>	Statement	True	False		The server can send packets to Computer B and the router at the same time.		✓	(1)	Computer C uses the IP address of a web server to send a request for a web page on the web server	✓		(1)	Computer B can read a packet sent from Computer A to Computer C.	✓		(1)	The server can read all incoming packets from the Internet.	✓	✓	(1)	4
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1(c)(i)	<ul style="list-style-type: none"> • Only one transmission is allowed on the bus at <u>any one time</u> // only one packet can be transmitted on the bus at <u>any one time</u> (1) • The two packets from A and B cannot both use the bus at the same time (1) • The attempts to transmit will be unsuccessful, because the stations will realise that the bus is busy (1) • Reference to CSMA/CD (1) • Collision causes a change in voltage of the bus (1) <p style="text-align: right;">1 mark for each point, max 2</p>	2																				
1(c)(ii)	<p>One mark for valid point, max 2</p> <ul style="list-style-type: none"> • Calculate a <u>random</u> wait time • Wait for the <u>random</u> time • Check for idle bus // Check status of bus • Attempt to re-transmit / re-send • If unable to transmit, repeat process 	2																				

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1(d)(i)	<ul style="list-style-type: none"> • Star topology (1) • Where each computer / device has its own <u>dedicated connection</u> to the server (1) <p>Alternative answers:</p> <p>Mesh topology (1) Every device <u>connects</u> directly to every other device (1)</p> <p>Ring topology (1) Use of <u>tokens</u> means no collisions // Every device examines every packet (1)</p>	2
1(d)(ii)	<p>As each computer is now not sharing a single bus // has dedicated path (to the server) (1) Collisions <u>cannot</u> occur (1)</p> <p>Alternative answers:</p> <p>Mesh As each device now has a direct path <u>to all the others</u> (1) Collisions <u>cannot</u> occur (1)</p> <p>Ring Packets all travel in the same direction (1) Collisions <u>cannot</u> occur (1)</p>	2

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2(a)	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; text-align: center; vertical-align: top;"> <p>Description</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">It has a simplified set of instructions.</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Emphasis is on the hardware rather than the software.</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">It makes extensive use of general purpose registers.</div> <div style="border: 1px solid black; padding: 5px;">Many instruction formats are available.</div> </td> <td style="width: 50%; text-align: center; vertical-align: top;"> <p>Type of processor</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 20px;">CISC</div> <div style="border: 1px solid black; padding: 5px;">RISC</div> </td> </tr> </table> <p>1 mark for each correct line</p>	<p>Description</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">It has a simplified set of instructions.</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Emphasis is on the hardware rather than the software.</div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">It makes extensive use of general purpose registers.</div> <div style="border: 1px solid black; padding: 5px;">Many instruction formats are available.</div>	<p>Type of processor</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 20px;">CISC</div> <div style="border: 1px solid black; padding: 5px;">RISC</div>	4																																																													
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2(b)(i)	<p>One mark per point – max 2</p> <ul style="list-style-type: none"> • Pipelining is instruction level parallelism • Execution (A: processing) of an instruction is split into a number of stages • When first stage for an instruction is completed the first stage of the next instruction can start executing • Another instruction can start executing before the previous one is finished • Processing of a number of instructions can be concurrent / simultaneous 	2																																																															
2(b)(ii)	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 30%;"></th> <th colspan="8">Time Interval</th> </tr> <tr> <th>Stage</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>8</th> </tr> </thead> <tbody> <tr> <td>Fetch instruction</td> <td>D</td> <td>E</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Read registers and decode instruction</td> <td></td> <td>D</td> <td>E</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Execute instruction</td> <td></td> <td></td> <td>D</td> <td>E</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Access operand in memory</td> <td></td> <td></td> <td></td> <td>D</td> <td>E</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Write result to register</td> <td></td> <td></td> <td></td> <td></td> <td>D</td> <td>E</td> <td></td> <td></td> </tr> </tbody> </table> <p>D at time interval 1 (1) D and E in second row (in that order) (1) Remainder completed correctly (1)</p>		Time Interval								Stage	1	2	3	4	5	6	7	8	Fetch instruction	D	E							Read registers and decode instruction		D	E						Execute instruction			D	E					Access operand in memory				D	E				Write result to register					D	E			3
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Question	Answer	Marks
2(c)(i)	Two from: <ul style="list-style-type: none">• The result of the first addition is not stored in (register) r3 (1)• Before the next instruction needs to load value from r3 (1)• There is a data dependency issue (1)• r3 is being fetched and stored on the same clock pulse (1)	2
2(c)(ii)	The third instruction is not dependent on the first two, therefore, instruction 2 and 3 need to be swapped	1

Question	Answer	Marks
3(a)(i)	A: Guest (operating system) (1) B: Host (operating system) (1)	2
3(a)(ii)	One mark for each valid point, max 3 <ul style="list-style-type: none"> • Guest OS (A) handles request as if it were running on its own physical machine // guest OS (A) is not aware it is running on a virtual platform • Guest OS (A) handles the request as usual • I/O requests are translated by the virtual machine software • Into instructions executed by host OS (B) • Host OS (B) retrieves the data from the file • Host OS (B) passes the data to the virtual machine software • The virtual machine software passes the data to the guest OS (A) • Guest OS passes the data to the application 	3
3(b)(i)	One mark from: <ul style="list-style-type: none"> • Because software can be tried on different OS using same hardware • Because no need to purchase / request all sorts of different hardware • Easier to recover if software causes system crash • VM provides protection to other software / host OS from malfunctioning software 	1
3(b)(ii)	Max 2 marks per limitation, max 2 limitations – max 4 marks <p>Virtual machine may not be able to emulate some hardware ... So that hardware cannot be tested using a virtual machine ... By relevant example, e.g. developing hardware drivers</p> <p>Using virtual machine means execution of extra code // processing time increased ... so cannot accurately test speed of real performance</p> <p>A virtual machine might not be as efficient ... By relevant example, e.g. might not be able to access sufficient memory</p>	4

Question	Answer	Marks
4(a)(i)	Because a valid unsigned integer can be two digits / one or more digits (1) Both 3 and 2 are digits (1)	2
4(a)(ii)	Because a valid unsigned number can be an unsigned integer followed by a decimal point followed by an unsigned integer (1) 32 is an unsigned integer and 5 is an unsigned integer (because it is a digit) and there is a point in between (1) Alternative response for 2 marks, combination of order and validity: 32 is a (valid) unsigned integer, followed by a decimal point, and 5 which is another (valid) unsigned integer Validity mark must refer to 32 and 5	2
4(b)	<pre> <unsigned number> ::= <unsigned_integer> (1) <unsigned_integer>.<unsigned_integer> (1) </pre> <p>Accept order reversed:</p> <pre> <unsigned_integer> ::= <digit> (1) <digit> <unsigned_integer> (1) </pre> <p>Accept <digit> <unsigned_integer> <digit></p> <p>If order reversed mark as above</p> <pre> <digit> ::= 1 2 3 4 5 6 7 8 9 0 (1) </pre> <p>Accept the list in any order, as long as all 10 digits included</p>	5

Question	Answer	Marks
4(c)(i)	<div style="border: 1px solid black; padding: 10px;"> <p>MP1: Line to indicate exponent is optional (B line) (1) MP2: 'E' present at start of exponent (1) MP3: Optional '+' or '-' (1) MP4: Unsigned integer (1)</p> <p>Alternative correct answer: MP3 needs both the sign 'box' and the sign diagram for the mark</p> <p>Sign:</p> </div>	4

Question	Answer	Marks
4(c)(ii)	<pre> <unsigned number> ::= <unsigned_integer > <unsigned integer>.<unsigned_integer> (1) Accept any order <unsigned_integer > <exponent> <unsigned integer>.<unsigned_integer> <exponent> (1) Accept any order <exponent> ::= E <sign> <unsigned_integer> E <unsigned integer> (1) <sign> ::= + - (1) </pre>	4

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5(a)	<table border="1" data-bbox="308 253 821 504"> <thead> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	A	B	X	0	0	1	0	1	0	1	0	0	1	1	0	1																					
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5(c)(i)	Clock (pulse)	1																																				
5(c)(ii)	<p>Max 2 marks per problem – max 4 marks</p> <p>Problem 1</p> <ul style="list-style-type: none"> One combination of S and R gives NOT valid / indeterminate output // Q and \bar{Q} have the same value The JK flip-flop does not allow for Q and \bar{Q} to have the same value for any combination of inputs // \bar{Q} and Q have to be complementary <p>Problem 2</p> <ul style="list-style-type: none"> Inputs may not arrive at the same time The JK flip-flop has a clock pulse to synchronise inputs 	4																																				

Question	Answer	Marks
6(a)	<p>One mark for suitable sensor, one mark for justification Max one sensor, max two marks</p> <p>humidity ... to ensure that the plants have the right level of moisture in the air</p> <p>pressure / proximity ... to detect whether the windows are open or closed condone '<i>check</i>'</p> <p>moisture ... to ensure the water levels in the soil are correct</p> <p>light ... to ensure the light levels in the greenhouse are correct for plant growth ... to ensure the windows are closed when night falls</p> <p>Accept pH sensor for one mark only</p> <p>Accept CO₂ sensor for one mark only, accept gas or O₂ for one mark only</p> <p>Justification needs to answer the question why? Not just describe the sensor</p> <p>Accept suitable actions resulting from sensor readings as justification</p>	2
6(b)	<p>Three from:</p> <ul style="list-style-type: none"> • Actions taken by system // or by example: e.g. adjust heater / turn on sprinkler / open windows • May affect the readings taken by the sensors // or by example • Which in turn may cause a change in the actions taken by the system // or by example • This is a continuous process... 	3
6(c)(i)	<p>One from:</p> <ul style="list-style-type: none"> • Lowest allowable temperature • Highest allowable temperature • Sampling time interval 	1

Question	Answer	Marks
6(c)(ii)	<p>If answer to c(i) is highest allowable or lowest allowable temperature:</p> <ul style="list-style-type: none"> • The sensor reading is compared to a stored parameter (1) • Depending upon result of comparison an action may or may not be carried out (1) <p>If answer to c(i) is sampling time interval:</p> <ul style="list-style-type: none"> • The higher the sampling rate... (1) • ...The better / more efficient is the control system (1) 	2
6(d)(i)	20	1
6(d)(ii)	<pre>LDD 4002 // load the contents of the 16 bit location containing the value for Sensor 5 into the Accumulator LSR #8 // move the bits in the Accumulator so that the Accumulator stores the value of Sensor 5 as unsigned 16-bit binary integer</pre> <p>1 mark for 4002</p> <p>1 mark for LSR</p> <p>1 mark for #8</p>	3