
COMPUTER SCIENCE**9608/31**

Paper 3 Written Paper

October/November 2017

MARK SCHEME

Maximum Mark: 75

Published

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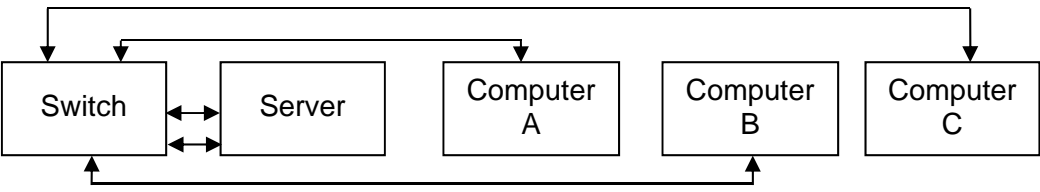
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Cambridge International will not enter into discussions about these mark schemes.

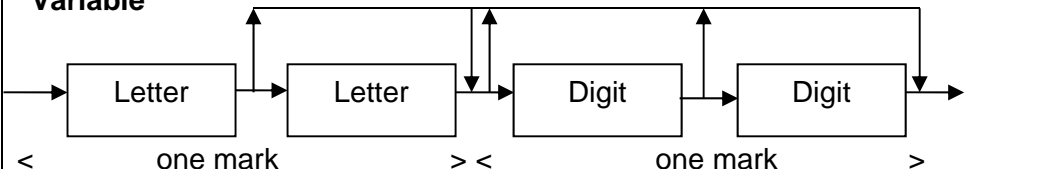
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This document consists of **8** printed pages.

Question	Answer	Marks																				
1(a)	 <p data-bbox="296 477 1046 510">Three lines with arrows – one from each device to switch</p>	1																				
1(b)	<table border="1" data-bbox="296 544 1289 958"> <thead> <tr> <th data-bbox="296 544 1026 595">Statement</th> <th data-bbox="1026 544 1158 595">True</th> <th data-bbox="1158 544 1289 595">False</th> <th data-bbox="1289 544 1350 595"></th> </tr> </thead> <tbody> <tr> <td data-bbox="296 595 1026 678">The server can send packets to Computer B and Computer C at the same time.</td> <td data-bbox="1026 595 1158 678">✓</td> <td data-bbox="1158 595 1289 678"></td> <td data-bbox="1289 595 1350 678">1</td> </tr> <tr> <td data-bbox="296 678 1026 761">The network software on each computer needs to include collision detection and avoidance.</td> <td data-bbox="1026 678 1158 761"></td> <td data-bbox="1158 678 1289 761">✓</td> <td data-bbox="1289 678 1350 761">1</td> </tr> <tr> <td data-bbox="296 761 1026 844">Computer B can read the packet sent from the server to Computer C.</td> <td data-bbox="1026 761 1158 844"></td> <td data-bbox="1158 761 1289 844">✓</td> <td data-bbox="1289 761 1350 844">1</td> </tr> <tr> <td data-bbox="296 844 1026 958">Computer A can send a packet to Computer B and at the same time the server can be sending a packet to Computer C.</td> <td data-bbox="1026 844 1158 958">✓</td> <td data-bbox="1158 844 1289 958"></td> <td data-bbox="1289 844 1350 958">1</td> </tr> </tbody> </table>	Statement	True	False		The server can send packets to Computer B and Computer C at the same time.	✓		1	The network software on each computer needs to include collision detection and avoidance.		✓	1	Computer B can read the packet sent from the server to Computer C.		✓	1	Computer A can send a packet to Computer B and at the same time the server can be sending a packet to Computer C.	✓		1	4
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Computer A can send a packet to Computer B and at the same time the server can be sending a packet to Computer C.	✓		1																			
1(c)(i)	<p data-bbox="296 999 1334 1227"> Device: Server 1 The server can provide a (software) firewall // The server can check all internet traffic // Server acts as proxy 1 Device: Switch 1 Internet traffic by passes the server // Server not overloaded with internet traffic // connected to all computers 1 1 mark for device, 1 mark for suitable reason </p>	2																				
1(c)(ii)	<ul data-bbox="320 1267 1289 1581" style="list-style-type: none"> • Router acts as gateway • Router acts as a firewall • The LAN and the Internet are two different networks • (may) operate on different protocols • Router forwards packets between networks • Router has a public IP address • Router holds a list of local addresses • Router translates local addresses to Internet (IP) addresses (and vice versa) <p data-bbox="951 1581 1334 1615">1 mark for each point, max 2</p>	2																				
1(c)(iii)	<ul data-bbox="320 1653 1238 1854" style="list-style-type: none"> • Each packet has the IP address of the web server / destination address • The routers use routing tables • Routers on the Internet forward packets towards destination • Packets can take different routes from source to destination • Packets are reassembled in order at the web server <p data-bbox="951 1854 1334 1888">1 mark for each point, max 3</p>	3																				

Question	Answer	Marks										
2(a)	<table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; width: 50%; border: none;">Description</th> <th style="text-align: center; width: 50%; border: none;">Computer architecture</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black; padding: 5px; width: 50%;">Most parallel computer systems use this architecture.</td> <td style="border: 1px solid black; padding: 5px; width: 50%; text-align: center;">SIMD</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">Widely used to process 3D graphics in video games.</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">MIMD</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">A microprocessor is used to control a washing machine.</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">MISD</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px;">There are a number of processing units. Each processing unit executes the same instruction but on different data</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">SISD</td> </tr> </tbody> </table> <p style="text-align: right; margin-top: 10px;">1 mark for each correct line</p>	Description	Computer architecture	Most parallel computer systems use this architecture.	SIMD	Widely used to process 3D graphics in video games.	MIMD	A microprocessor is used to control a washing machine.	MISD	There are a number of processing units. Each processing unit executes the same instruction but on different data	SISD	4
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There are a number of processing units. Each processing unit executes the same instruction but on different data	SISD											
2(b)	<ul style="list-style-type: none"> • Only one (separate) processor / not many separate processors (is not massively parallel) 1 • Quad core computer system // processing units share the same bus 1 <p style="text-align: right;">1 mark for each point, max 2</p>	2										
2(c)	<ul style="list-style-type: none"> • Split into blocks of code • ... that can be processed simultaneously ... • ... instead of sequentially • Each block is processed by a different processor • which allows each of the many processors to simultaneously process the different blocks of code independently • Requires both parallelism and co-ordination <p style="text-align: right;">1 mark for each point, max 2</p>	2										
2(d)	<p>1 mark for identification of hardware issue, for example:</p> <ul style="list-style-type: none"> • Communication between the different processors is the issue <p>1 mark for further explanation from:</p> <ul style="list-style-type: none"> • Each processor needs a link to every other processor • Many processors require many of these links • Challenging topology 	2										

Question	Answer	Marks
3(a)(i)	There should be a colon before the '=' sign	1
3(a)(ii)	The second operand should be an unsigned integer and not a variable	1
3(a)(iii)	A32 is not a variable, as a variable should be a letter followed by a single digit	1
3(b)	<pre> <assignment_statement> ::= <variable> := <variable> <operator> <unsigned_integer> <variable> ::= <letter> <digit> <unsigned_integer> ::= <digit> <digit> <unsigned_integer> <letter> ::= A B C <operator> ::= + - * ^ </pre>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>
3(c)	<p>Variable</p>  <p>Syntax diagram shows one or two letters</p> <p>Syntax diagram shows zero, one or two digits</p>	<p>2</p> <p>1</p> <p>1</p>
3(d)	<pre> <assignment_statement> ::= <variable> := <variable> <operator> <real> <real> ::= <unsigned_integer> . <unsigned_integer> </pre>	<p>2</p> <p>1</p> <p>1</p>

Question	Answer	Marks
4(a)(i)	A (known) set of rules Agreed/standard method for data transmission // governs how two devices communicate	1 1 2
4(a)(ii)	Max 2 marks for purpose: <ul style="list-style-type: none"> • Purpose of TLS is to provide for secure communication (over a network) • maintain data integrity • additional layer of security Max 2 marks for further explanation from: <ul style="list-style-type: none"> • TLS provides improved security over SSL • TLS is composed of two layers / record protocol and handshake protocol • TLS protects this information by using encryption • Also allows for authentication of servers and clients 	Max 3
4(b)	<ul style="list-style-type: none"> • The client validates (the server's) TLS Certificate • The client sends its digital certificate (to the server if requested) • Client sends an encrypted message to the server using the server's public key • The server can use its private key to decrypt the message ... • ... and get data needed for generating symmetric key • Both server and client compute symmetric key (to be used for encrypting messages) // session key established • The client sends back a digitally signed acknowledgement to start an encrypted session • The server sends back a digitally signed acknowledgement to start an encrypted session <p style="text-align: right;">1 mark for each point, max 3 points</p>	3
4(c)	Applications, for example: <ul style="list-style-type: none"> • online banking • private email • online shopping • online messaging etc. <p style="text-align: right;">1 mark for each point, Max 2</p>	2

Question	Answer	Marks															
5(a)(i)	<table border="1" style="display: inline-table; vertical-align: middle;"> <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>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	A	B	X	0	0	1	0	1	1	1	0	1	1	1	0	1
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5(b)(ii)	<ul style="list-style-type: none"> • Q and \bar{Q} have same value • Q and \bar{Q} should be complements of each other • Flip-flop becomes unstable <p style="text-align: right;">1 mark for each point, max 2</p>	2																																																																												
5(c)(i)	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th rowspan="2">J</th> <th rowspan="2">K</th> <th rowspan="2">Clock</th> <th rowspan="2">Working space</th> <th colspan="2">Initial values</th> <th colspan="2">Final values</th> </tr> <tr> <th>Q</th> <th>\bar{Q}</th> <th>Q</th> <th>\bar{Q}</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>1</td><td></td><td>1</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td></td><td>0</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>1</td><td></td><td>1</td><td>0</td><td>0</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>1</td><td></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></td><td>1</td><td>0</td><td style="background-color: #e0e0e0;">1</td><td style="background-color: #e0e0e0;">0</td></tr> <tr><td>1</td><td>0</td><td>1</td><td></td><td>0</td><td>1</td><td style="background-color: #e0e0e0;">1</td><td style="background-color: #e0e0e0;">0</td></tr> <tr><td>1</td><td>1</td><td>1</td><td></td><td>1</td><td>0</td><td style="background-color: #e0e0e0;">0</td><td style="background-color: #e0e0e0;">1</td></tr> <tr><td>1</td><td>1</td><td>1</td><td></td><td>0</td><td>1</td><td style="background-color: #e0e0e0;">1</td><td style="background-color: #e0e0e0;">0</td></tr> </tbody> </table> <p style="text-align: right;">1 mark per shaded row</p>	J	K	Clock	Working space	Initial values		Final values		Q	\bar{Q}	Q	\bar{Q}	0	0	1		1	0	1	0	0	0	1		0	1	0	1	0	1	1		1	0	0	1	0	1	1		0	1	0	1	1	0	1		1	0	1	0	1	0	1		0	1	1	0	1	1	1		1	0	0	1	1	1	1		0	1	1	0	4
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5(c)(ii)	<ul style="list-style-type: none"> • S-R flip-flop has an invalid combination of S and R // The S_R flip flop allows both Q and \bar{Q} to have the same value // S-R flip-flop inputs may arrive at different times 1 • The J-K flip-flop does not allow for Q and \bar{Q} to have the same value // All four combination of values for J and K are valid // J-K flip-flop incorporates a clock pulse for synchronisation 1 	2																																																																												

Question	Answer	Marks
5(d)	<ul style="list-style-type: none"> • A flip-flop can store either a 0 or a 1 • Computers use bits to store data • Flip-flops can therefore be used to store bits (of data) • Memory can be created from flip-flops <p style="text-align: right;">1 mark for valid point, max 2</p>	2

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6(a)(i)	Control system	1																																																																																
6(a)(ii)	System is controlling devices // turns heaters on and off // use of actuators maintain the environment // makes use of feedback	1																																																																																
6(b)	Computer/microprocessor ... to process the sensor readings Analogue to digital convertor ... <u>Sensor</u> produces analogue signal but processor requires digital data Digital to analogue convertor ... <u>Processor</u> produces digital signal but actuator may require analogue sign Actuator ... May be required to turn heater on or off <p style="text-align: right;">1 mark for device, 1 mark for justification, max 2 devices</p>	4																																																																																
6(c)(i)	One mark per column excluding LOWTEMP <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>LOWTEMP</th> <th>LOWREG</th> <th>COUNTER</th> <th>ACC</th> <th>IX</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>B00000000</td> <td>1</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>0</td> </tr> <tr> <td></td> <td></td> <td></td> <td>17</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>1</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>2</td> <td></td> </tr> <tr> <td></td> <td></td> <td>2</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>1</td> </tr> <tr> <td></td> <td></td> <td></td> <td>14</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>B00000000</td> <td></td> </tr> <tr> <td></td> <td>B00000010</td> <td></td> <td>B00000010</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>2</td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>4</td> <td></td> </tr> <tr> <td></td> <td></td> <td>4</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>2</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	LOWTEMP	LOWREG	COUNTER	ACC	IX	15	B00000000	1							0				17					1					2				2							1				14					B00000000			B00000010		B00000010					2					4				4							2						4
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6(c)(ii)	<ul style="list-style-type: none"> • COUNTER has an initial value of 1 • Test for final value is before COUNTER updated • COUNTER is doubled in value each time around loop • six sensors values/bits to check • COUNTER is doubled in value 6 times // 2^5 • Values of COUNTER at test will therefore be 1 – 2 – 4 – 8 – 16 – 32 <p style="text-align: right;">1 mark for valid point, max 2</p>	2																																																																																

Question	Answer	Marks
6(c)(iii)	<ul style="list-style-type: none">• Load the contents of LOWREG into ACC• Check bit position in LOWREG• For each of the least significant 6 bits• Use AND operation / mask to isolate a bit• Jump to code corresponding to bit being looked at• if value of bit is 1• Send signal to appropriate actuator to turn on the heater <p style="text-align: right;">1 mark for valid point, max 3</p>	3