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COMPUTER SCIENCE **9608/31**

Paper 3 Written Paper **October/November 2017**

MARK SCHEME

Maximum Mark: 75

Published

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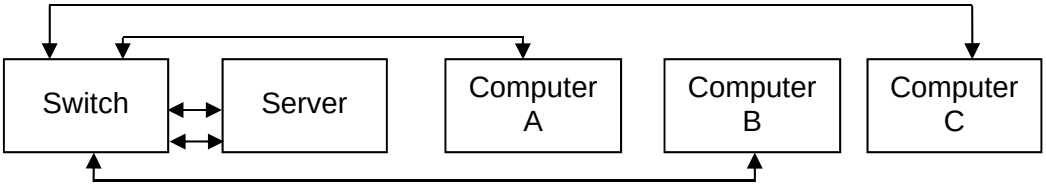
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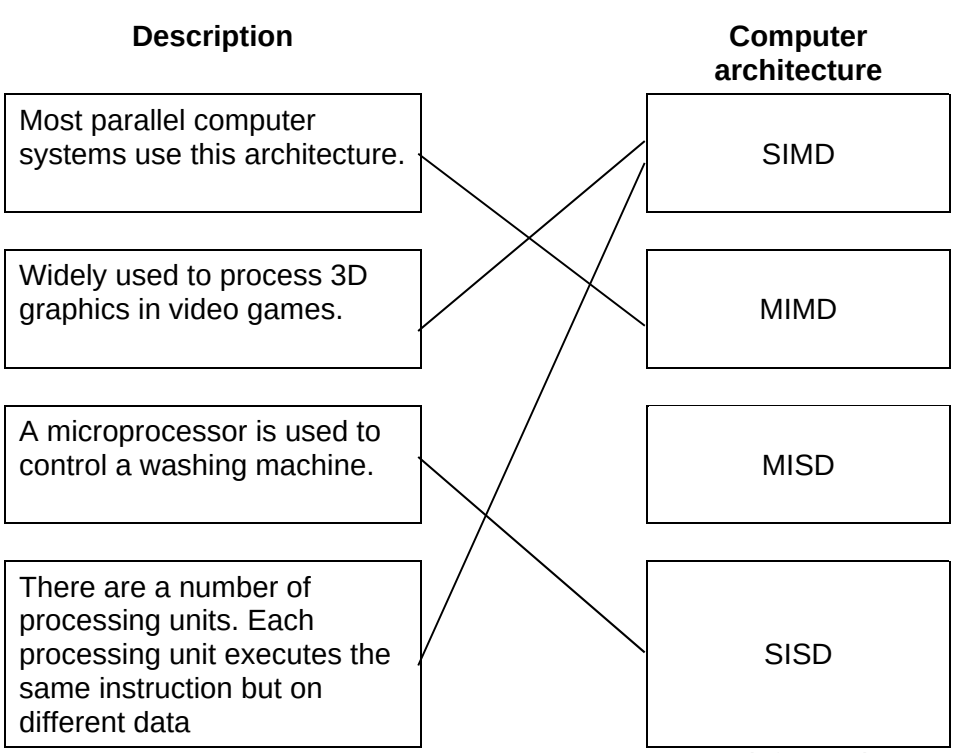
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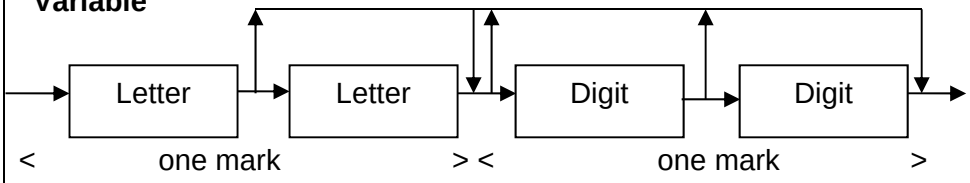
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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>

Three lines with arrows – one from each device to switch</td><td>1</td></tr>
<tr><td>1(b)</td><td>
<table>
<tr><th>Statement</th><th>True</th><th>False</th><th></th></tr>
<tr><td>The server can send packets to Computer B and Computer C at the same time.</td><td>✓</td><td></td><td>1</td></tr>
<tr><td>The network software on each computer needs to include collision detection and avoidance.</td><td></td><td>✓</td><td>1</td></tr>
<tr><td>Computer B can read the packet sent from the server to Computer C.</td><td></td><td>✓</td><td>1</td></tr>
<tr><td>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>✓</td><td></td><td>1</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>1(c)(i)</td><td>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</td><td>2</td></tr>
<tr><td>1(c)(ii)</td><td>• 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)
1 mark for each point, max 2</td><td>2</td></tr>
<tr><td>1(c)(iii)</td><td>• 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
1 mark for each point, max 3</td><td>3</td></tr>
</table>

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Question	Answer	Marks
2(a)	 1 mark for each correct line	**4**
2(b)	• Only one (separate) processor / not many separate processors (is not massively parallel) 1 • Quad core computer system // processing units share the same bus 1 **1 mark** for each point, **max 2**	**2**
2(c)	• 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 **1 mark** for each point, **max 2**	**2**
2(d)	**1 mark** for identification of hardware issue, for example: • Communication between the different processors is the issue **1 mark** for further explanation from: • 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)	`<assignment_statement> ::= <variable> :=` 1 `<variable> <operator> <unsigned_integer>` 1 `<variable> ::= <letter> <digit>` 1 `<unsigned_integer> ::= <digit> |` 1 `<digit> <unsigned_integer>` 1 `<letter> ::= A | B | C` 1 `<operator> ::= + | - | * | ^`	**6**
3(c)	**Variable**  Syntax diagram shows one or two letters 1 Syntax diagram shows zero, one or two digits 1	**2**
3(d)	`<assignment_statement> ::=` `<variable> := <variable> <operator> <real>` 1 `<real> ::= <unsigned_integer> . <unsigned_integer>` 1	**2**

Question	Answer	Marks
4(a)(i)	A (known) set of rules 1 Agreed/standard method for data transmission // governs how two devices communicate 1	**2**
4(a)(ii)	**Max 2 marks** for purpose: • 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: • 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)	• 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 **1 mark** for each point, **max 3** points	**3**
4(c)	Applications, for example: • online banking • private email • online shopping • online messaging etc. **1 mark** for each point, **Max 2**	**2**

Question	Answer	Marks
5(a)(i)		**1**

A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

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5(a)(ii) — **1**

A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

5(b)(i) — **3**

	S	R	Q	$\overline{Q}$	
Initially	1	0	0	1	
R changed to 1	1	1	**0**	**1**	1
S changed to 0	0	1	**1**	**0**	1
S changed to 1	1	1	**1**	**0**	1
S and R changed to 0	0	0	1	1	

5(b)(ii) — **2**

- Q and $\overline{Q}$ have same value
- Q and $\overline{Q}$ should be complements of each other
- Flip-flop becomes unstable

1 mark for each point, **max 2**

5(c)(i) — **4**

J	K	Clock	Working space	Initial values Q	Initial values $\overline{Q}$	Final values Q	Final values $\overline{Q}$
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**

1 mark per shaded row

5(c)(ii) — **2**

- S-R flip-flop has an invalid combination of S and R // The S_R flip flop allows both Q and $\overline{Q}$ 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 $\overline{Q}$ 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

Question	Answer	Marks
5(d)	• 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 **1 mark** for valid point, **max 2**	**2**

Question	Answer	Marks
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 … Sensor produces analogue signal but processor requires digital data Digital to analogue convertor … Processor produces digital signal but actuator may require analogue sign Actuator … May be required to turn heater on or off **1 mark** for device, **1 mark** for justification, **max 2** devices	**4**
6(c)(i)	One mark per column excluding LOWTEMP	**4**
6(c)(ii)	• 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 **1 mark** for valid point, **max 2**	**2**

LOWTEMP	LOWREG	COUNTER	ACC	IX
15	B00000000	1		
				0
			17	
			1	
			2	
		2		
				1
			14	
			B00000000	
	B00000010		B00000010	
			2	
			4	
		4		
				2

Question	Answer	Marks
6(c)(iii)	• 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 **1 mark** for valid point, **max 3**	**3**

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