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COMPUTER SCIENCE **9608/31**

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

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.

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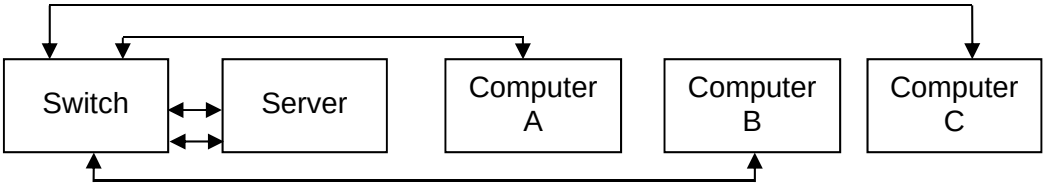
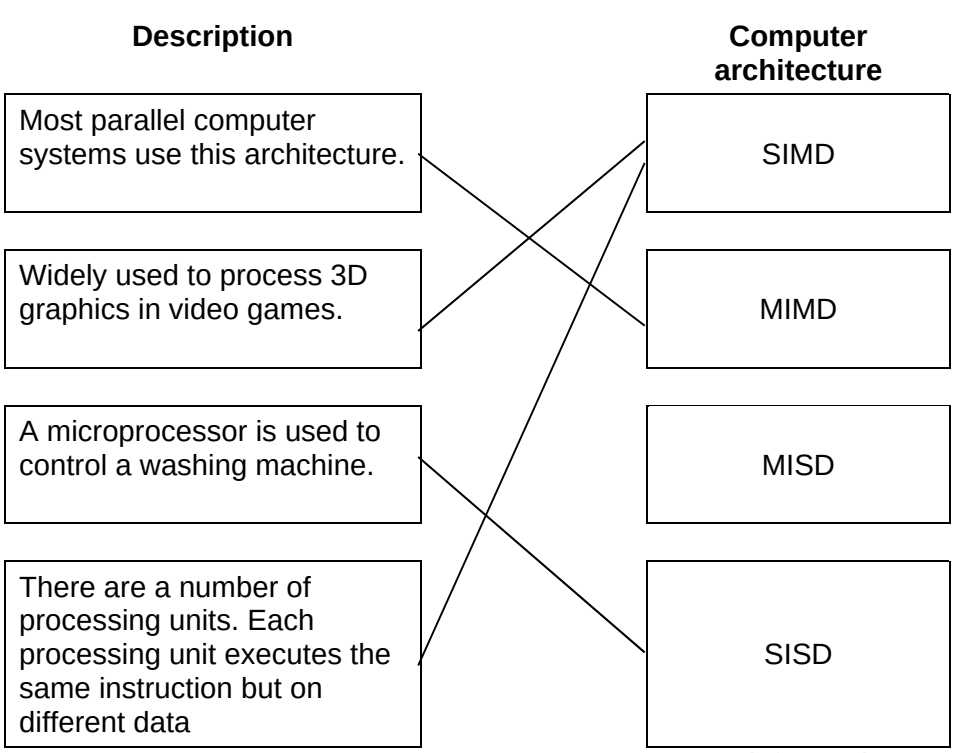
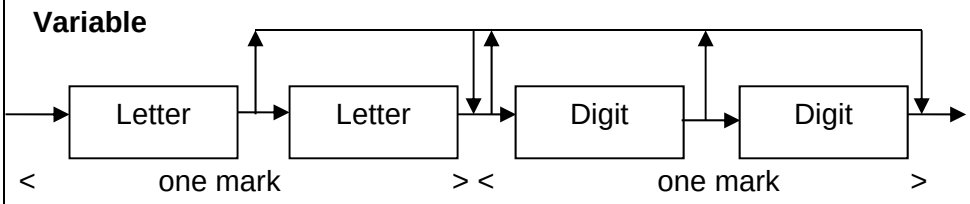
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td> 

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>

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

Question 5(a)(ii) — **Marks: 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

Question 5(b)(i) — **Marks: 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	

Question 5(b)(ii) — **Marks: 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**

Question 5(c)(i) — **Marks: 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

Question 5(c)(ii) — **Marks: 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**