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COMPUTER SCIENCE **9608/32**

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

MARK SCHEME

Maximum Mark: 75

Published

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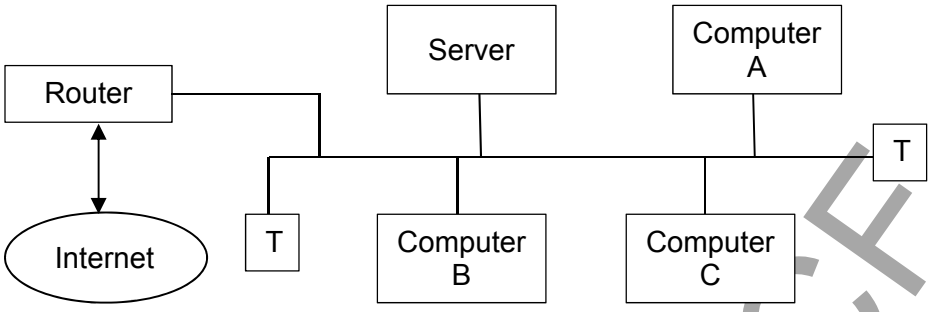
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td> 

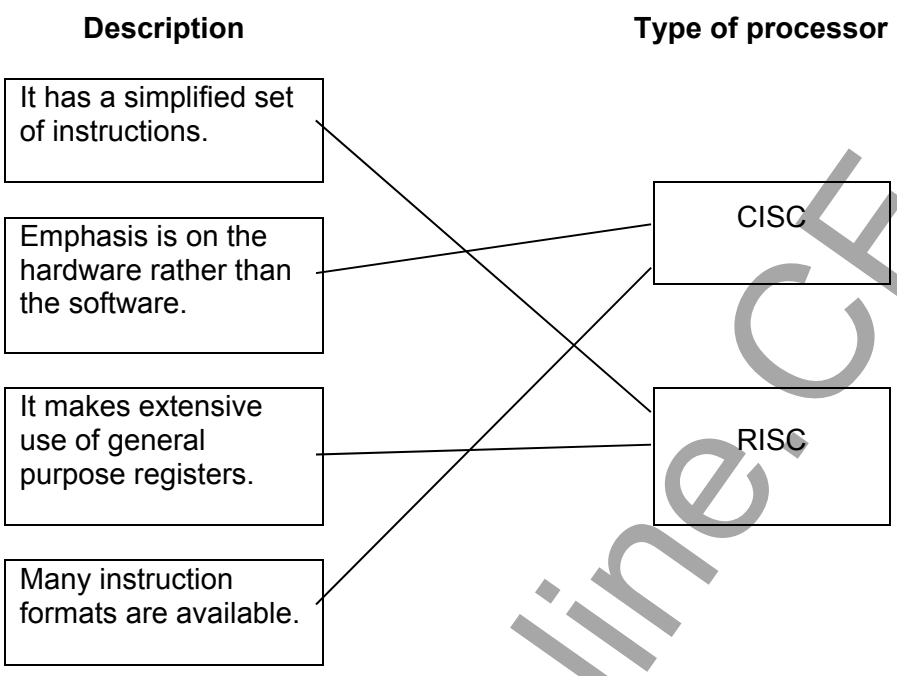
Each device has a single connection to the bus (1)

One terminator at each end (1)

The terminators do not need to be labelled as long as they are obvious</td><td>2</td></tr>
<tr><td>1(b)</td><td><table>
<tr><th>Statement</th><th>True</th><th>False</th></tr>
<tr><td>The server can send packets to Computer B and the router at the same time.</td><td></td><td>✓</td></tr>
<tr><td>Computer C uses the IP address of a web server to send a request for a web page on the web server</td><td>✓</td><td></td></tr>
<tr><td>Computer B can read a packet sent from Computer A to Computer C.</td><td>✓</td><td></td></tr>
<tr><td>The server can read all incoming packets from the Internet.</td><td>✓</td><td>✓</td></tr>
</table>(1) (1) (1) (1)</td><td>4</td></tr>
<tr><td>1(c)(i)</td><td>• 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)
1 mark for each point, **max 2**</td><td>2</td></tr>
<tr><td>1(c)(ii)</td><td>**One mark** for valid point, **max 2**

• 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</td><td>2</td></tr>
</table>

Question	Answer	Marks
1(d)(i)	• Star topology (1) • Where each computer / device has its own dedicated connection to the server (1) Alternative answers: Mesh topology (1) Every device connects directly to every other device (1) Ring topology (1) Use of tokens means no collisions // Every device examines every packet (1)	**2**
1(d)(ii)	As each computer is now not sharing a single bus // has dedicated path (to the server) (1) Collisions cannot occur (1) Alternative answers: Mesh As each device now has a direct path to all the others (1) Collisions cannot occur (1) Ring Packets all travel in the same direction (1) Collisions cannot occur (1)	**2**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>


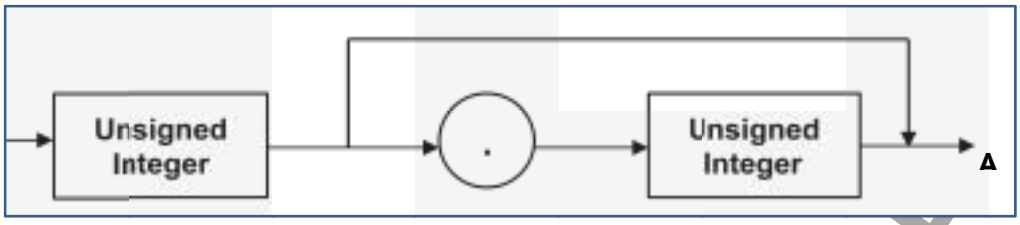
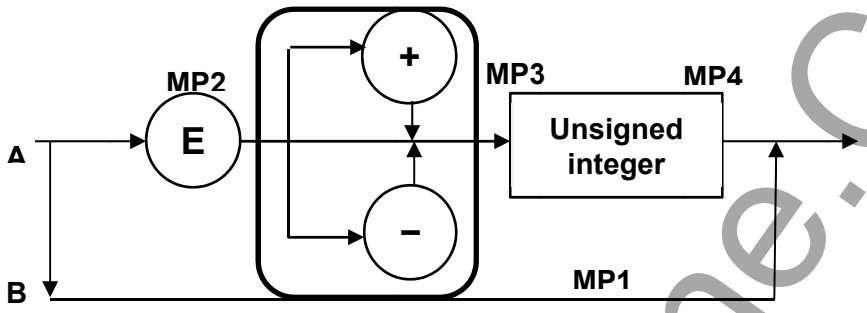
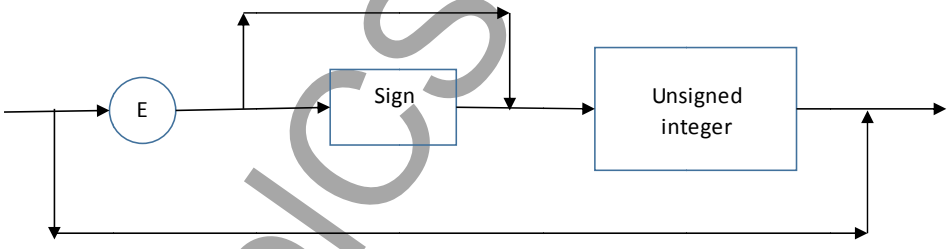
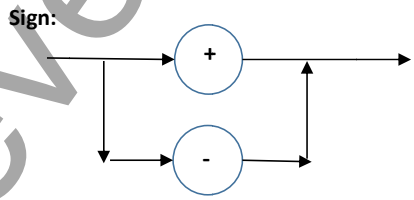
1 mark for each correct line
</td><td>4</td></tr>
<tr><td>2(b)(i)</td><td>
One mark per point – max 2

• 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
</td><td>2</td></tr>
<tr><td>2(b)(ii)</td><td>
<table>
<tr><th></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>
<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>
</table>
D at time interval 1 (1)
D and E in second row (in that order) (1)
Remainder completed correctly (1)
</td><td>3</td></tr>
</table>

Question	Answer	Marks
2(c)(i)	**Two** from: • 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** • 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: • 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** 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 Using virtual machine means execution of extra code // processing time increased … so cannot accurately test speed of real performance A virtual machine might not be as efficient … By relevant example, e.g. might not be able to access sufficient memory	**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)	<unsigned number> ::= **<unsigned_integer> |** (1) **<unsigned_integer>.<unsigned_integer>** (1) Accept order reversed: <unsigned_integer> ::= **<digit> |** (1) **<digit> <unsigned_integer>** (1) Accept **<digit> |<unsigned_integer> <digit>** If order reversed mark as above <digit> ::= **1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0** (1) Accept the list in any order, as long as all 10 digits included	**5**

Question	Answer	Marks
4(c)(i)	  **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) Alternative correct answer: MP3 needs both the sign 'box' and the sign diagram for the mark  	**4**

Question	Answer	Marks
4(c)(ii)	<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)	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5(a)</td><td>
<table>
<tr><th>A</th><th>B</th><th>X</th></tr>
<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>
</table>
</td><td>1</td></tr>
<tr><td>5(b)</td><td>
<table>
<tr><th></th><th>S</th><th>R</th><th>Q</th><th>$\overline{Q}$</th><th></th></tr>
<tr><td>Initially</td><td>1</td><td>0</td><td>1</td><td>0</td><td></td></tr>
<tr><td>S changed to 0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>(1)</td></tr>
<tr><td>R changed to 1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>(1)</td></tr>
<tr><td>R changed to 0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>(1)</td></tr>
<tr><td>S and R changed to 1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>(1)</td></tr>
</table>
</td><td>4</td></tr>
<tr><td>5(c)(i)</td><td>Clock (pulse)</td><td>1</td></tr>
<tr><td>5(c)(ii)</td><td>Max 2 marks per problem – max 4 marks

Problem 1
• One combination of S and R gives NOT valid / indeterminate output // Q and $\overline{Q}$ have the same value
• The JK flip-flop does not allow for Q and $\overline{Q}$ to have the same value for any combination of inputs // $\overline{Q}$ and Q have to be complementary

Problem 2
• Inputs may not arrive at the same time
• The JK flip-flop has a clock pulse to synchronise inputs</td><td>4</td></tr>
</table>

Question	Answer	Marks
6(a)	**One mark** for suitable sensor, **one mark** for justification **Max one sensor, max two marks** humidity … to ensure that the plants have the right level of moisture in the air pressure / proximity … to detect whether the windows are open or closed condone '*check*' moisture … to ensure the water levels in the soil are correct light … to ensure the light levels in the greenhouse are correct for plant growth … to ensure the windows are closed when night falls Accept pH sensor for one mark only Accept CO_2 sensor for one mark only, accept gas or O_2 for one mark only Justification needs to answer the question why? Not just describe the sensor Accept suitable actions resulting from sensor readings as justification	**2**
6(b)	**Three** from: • 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)	**One** from: • Lowest allowable temperature • Highest allowable temperature • Sampling time interval	**1**

Question	Answer	Marks
6(c)(ii)	If answer to **c(i)** is **highest allowable or lowest allowable temperature**: • 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) If answer to **c(i)** is **sampling time interval**: • The higher the sampling rate… (1) • …The better / more efficient is the control system (1)	**2**
6(d)(i)	20	**1**
6(d)(ii)	`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` 1 mark for 4002 1 mark for LSR 1 mark for #8	**3**