Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

COMPUTER SCIENCE **9608/31**

Paper 3 Written Paper **October/November 2019**

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.

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

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This document consists of **9** printed pages.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Question	Answer	Marks
1(a)(i)	**1 mark** per bullet point • Exponent 0010 = 2 • Mantissa 0.1010010 becomes 010.10010 // $\frac{41}{64}$ // $2+\frac{1}{2}+\frac{1}{16}$ • Answer $2\frac{9}{16}$ // 2.5625	**3**
1(a)(ii)	**1 mark** per bullet point • -3.75 = 100.01000 // $-4+\frac{1}{4}$ / 0.25 • 100.01000 becomes 1.0001000 Exponent = $+2$ • Answer: Mantissa = 10001000 Exponent = 0010	**3**
1(b)	Only the range is increased (no effect on precision)	**1**
1(c)	**1 mark** per bullet point to **max 1** • There is no **exact** binary conversion for some numbers • More bits are needed to store the number than are available	**1**
1(d)	First term: Overflow Second term: Underflow	**2**

Question	Answer	Marks
2(a)(i)	`35` is not a variable	**1**
2(a)(ii)	`:=` is not an operator	**1**
2(a)(iii)	`9` is not a digit	**1**

2(b)	**1 mark** for each bullet point
	
	`<operator>::=`
	• `== | > | <`
	
	`<number>::=`
	• `<digit><digit>`
	
	`<variable>::=`
	• `<letter>`
	• `|<letter><variable>`
	
	`<condition>::=`
	• `<variable><operator><number>`
	• `|<variable><operator><variable>`
		6

Question	Answer	Marks
3(a)	**1 mark** per bullet point to **max 2** • Provide a set of standards for transmission of data • … that gives a known/accepted set of rules for transmitting and receiving data • This enables communication/compatibility between devices from different manufacturers/platforms etc.	**2**
3(b)	**1 mark** per bullet point to **max 3** • Carrier Sense Multiple Access (with) Collision Detection • Before transmitting a device checks if the channel is busy • If it is busy the device waits // if channel free data is sent • When transmission begins the device listens for other devices also beginning transmission • If there is a collision, transmission is aborted / transmitting a jam signal • Both devices wait a (different) random time, then try again	**4**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>1 mark for 3 or 4 correct products
2 marks for all 5 correct products

$X = \bar{A}.\bar{B}.\bar{C} + \bar{A}.\bar{B}.C + \bar{A}.B.C + A.\bar{B}.C + A.B.C$</td><td>2</td></tr>
<tr><td>4(b)</td><td>1 mark for correct answer
AB
C
<table><tr><th></th><th>00</th><th>01</th><th>11</th><th>10</th></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table></td><td>1</td></tr>
<tr><td>4(c)</td><td>1 mark per correct loop
AB
C
<table><tr><th></th><th>00</th><th>01</th><th>11</th><th>10</th></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table></td><td>2</td></tr>
<tr><td>4(d)</td><td>1 mark per bullet point.

• $\bar{A}.\bar{B}$
• $+C$

$X = \bar{A}.\bar{B} + C$ // $X = C + \bar{A}.\bar{B}$</td><td>2</td></tr>
</table>

Question	Answer	Marks
5(a)	**1 mark** per bullet point to **max 2** • No suitable data type is provided by the language used • The programmer needs specify a new data type • … that meets the requirements of the application / program	**2**

5(b)(i)	**1 mark** per bullet point
	
	• `EmployeeID` declared as `STRING`
	• `Sales`, `Technical` and `CustomerServices` …
	• … with commas in-between
	• `ENDTYPE`
	
	`TYPE Employee`
	`  DECLARE EmployeeID  : STRING`
	`  DECLARE EmployeeName : STRING`
	`  DECLARE Department  : (Sales, Technical,`
	`  CustomerServices)`
	`  DECLARE Salary  : 25000..150000`
	`ENDTYPE`
		4

5(b)(ii)	`DECLARE NewEmployee : Employee`	**1**
5(b)(iii)	`NewEmployee.EmployeeID ← "02244"`	**1**
5(b)(iv)	**1 mark** per bullet point to **max 2** • Array • List • Set • Collection • Class • Stack • Queue • Linked list • Dictionary	**2**
6(a)	**1 mark** per bullet point Page: • Virtual Memory is divided into blocks of a fixed size Page frame: • the main memory is divided into page frames of the same size as a page Page table: • the Page (Map) table shows the mapping of pages to page frames	**3**

Question	Answer	Marks
6(b)	**1 mark** per bullet point to **max 3** • To allow multiprogramming / multitasking to take place • To ensure fair usage of the processor • To ensure fair usage of peripherals • To ensure fair usage of memory • To ensure higher priority tasks are executed sooner • To ensure all processes have the opportunity to finish	**3**
6(c)	A **signal** from a software **source** or hardware device seeking the **attention of the processer**	**1**
6(d)	**1 mark** per bullet point in the order given • JOB32 • JOB42 • JOB42	**3**

Question	Answer	Marks
7(a)	**1 mark** per bullet point • Application • Transport • Internet / Network • Data Link	**4**
7(b)(i)	**1 mark** per bullet point to **max 2** • Packet switching makes best use of the available (channel) capacity • … by using alternative routes • … which is more secure / robust • … as packets to / from different sources and destinations can share the same route	**2**
7(b)(ii)	**1 mark** per bullet point to **max 2** • To store data about packet • … and its routing // to ensure it reaches its destination • ... to ensure that message can be properly reconstructed	**2**

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Question	Answer	Marks
7(b)(ii)	**1 mark** per item to **max 3** For example: • IP address of sender • IP address of destination • IP version • Number of packets the message consists of • ID number of that packet • Protocol used • Packet length • Time to live // max number of hops • Synchronisation data • Source port • Destination Port • Checksum	**3**

Question	Answer	Marks
8(a)	**1 mark** per bullet point to **max 2** • Serial number • Identification of Certificate Authority (that issued the certificate) • Version (number) • Valid from // start date • Valid to // end date • Subject name (name of user/owner/computer/network device) • Subject's public key • Hashing algorithm • Algorithm used to create signature • Algorithm used to hash certificate • Hashed certificate	**2**
8(b)	**1 mark** for each correct term A **hashing** algorithm is used to generate a message digest from the plain text message. The message digest is **encrypted** with the sender's **private key**.	**3**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>9(a)</td><td>1 mark for each correct term
<table>
<tr><th>Description</th><th>Term</th></tr>
<tr><td>• There are several processors.
• Each processor executes different sets of instructions on one set of data at the same time.</td><td>MISD</td></tr>
<tr><td>• The processor has several ALUs.
• Each ALU executes the same set of instructions on different sets of data at the same time.</td><td>SIMD</td></tr>
<tr><td>• There is only one processor.
• The processor executes one set of instructions on one set of data.</td><td>SISD</td></tr>
<tr><td>• There are several processors.
• Each processor executes a different set of instructions.
• Each processor operates on different sets of data.</td><td>MIMD</td></tr>
</table></td><td>4</td></tr>
<tr><td>9(b)</td><td>1 mark per bullet point to max 3

• A large number of processors
• Collaborative processing // coordinated simultaneous processing
• Network infrastructure
• Communicate using a message interface / by sending messages</td><td>3</td></tr>
</table>