Cambridge Assessment International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9608/31**

Paper 3 Advanced Theory **May/June 2021**

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.

Cambridge International is publishing the mark schemes for the May/June 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

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[Turn over

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)	A – negative, mantissa starts with a one B – positive mantissa starts with a zero	**2**
1(a)(ii)	A mantissa: −0.5 // $-\frac{1}{2}$ A exponent: 2 B mantissa: 0.875 // 7/8 B exponent: −1	**4**
1(a)(iii)	A: −2 B: 0.4375 // 7/16	**2**
1(b)	Number: **B** Justification: Using the mantissa The first two bits are different // first bit 0 second bit 1	**3**

Question	Answer	Marks
2(a)	**One mark** for each correct row **Layer** / **Description** **Application** – Handles access to services // manages data exchange // defines protocols used **Transport** – Handles the forwarding of packets **Internet / Network** – Handles transmission of data /routing / IP addressing **Network Access / Interface // (Data) Link // Physical** – Handles how data is physically sent	**4**
2(b)(i)	**One** mark for each point max **two** • All data is (sent and received) using the same rules • All data is (sent and received) using the same formats • Allows communications between devices operating on different platforms • The communication is independent of the software used • The communication is independent of the hardware used	**2**

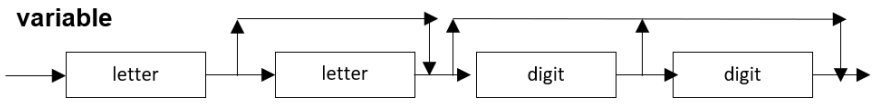
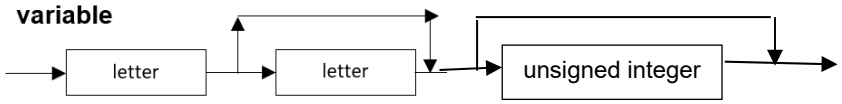
Question	Answer	Marks
2(b)(ii)	**One** mark for protocol, **one** mark for description, **one** mark for use For example: Protocol: FTP// File Transfer Protocol Purpose: To directly transfer data between two computers over a network Use: upload and download files over the Internet Protocol: SMTP // Simple Mail Transfer Protocol Purpose: protocol for sending email Use: used by mail servers to forward email messages Protocol: POP3 //Post Office Protocol 3 // IMAP // Internet Message Access Protocol Purpose: mail is held for you by a remote server until you download it Use: to receive **e-mail** Protocol: BitTorrent Purpose: protocol for peer-to-peer file sharing Use: decentralised distribution of data Protocol: Ethernet Purpose: To send/receive data along a **cable** Use: for local area networks Protocol: HTTP(S)//Hypertext Transfer Protocol (Secure) Purpose: transfer of web pages/hypertext Use: browsing websites Protocol: WiMAX // Worldwide Interoperability for Microwave Access (AXess) Purpose: to provide wireless broadband Use: where there is no wired infrastructure	**3**

Question	Answer	Marks
3	**One mark** for each point to **Max 6. Max 4** for Bus**, max 4** for Star **Bus** **Max 2:** • Diagram showing bus topology • Diagram with correct labels (e.g. Terminator, Workstation, Backbone) **Max 2:** • All nodes connected to a **single cable** … • … with a terminator at each end • Uses half duplex **Star** **Max 2:** • Diagram showing star topology • Diagram with correct labels (e.g. Server / Central Device, Workstation, Individual Connection) **Max 2:** • All nodes connected to a central device … • … each node has its own connection • All data is transferred via the central device • .. using a bi-directional connection	**6**

Question	Answer	Marks
4(a)(i)	**One** mark for 2 correct, **two** marks for 4 correct and no other terms $X = \overline{P}.\overline{Q}.\overline{R}.\overline{S} + \overline{P}.\overline{Q}.R.\overline{S} + P.Q.\overline{R}.S + P.Q.R.S$	**2**
4(a)(ii)	**Two marks** for fully correct K-map **One mark** for a K-map with one error **Zero marks for a** K-map **with two or more errors** **PQ** **RS** **00** 1 0 0 0 **01** 0 0 1 0 **11** 0 0 1 0 **10** 1 0 0 0	**2**

Question	Answer	Marks
4(a)(iii)	**One** mark for each correct loop **max two** **PQ** **RS** 00: 1, 0, 0, 0 01: 0, 0, 1, 0 11: 0, 0, 1, 0 10: 1, 0, 0, 0	**2**
4(a)(iv)	**One** mark per point • $\overline{P}.\overline{Q}.\overline{S}$ • $+P.Q.S$ $X = \overline{P}.\overline{Q}.\overline{S} + P.Q.S$	**2**
4(b)	**One** mark for correct use of distributive law **One** mark for correct use of complementary law **One** mark for correct use of redundancy law **One** mark for correct use of idempotent law **Max two** $X = \overline{P}.\overline{Q}.\overline{R}.\overline{S} + \overline{P}.\overline{Q}.R.\overline{S} + P.Q.\overline{R}.S + P.Q.R.S$ $X = \overline{P}.\overline{Q}.\overline{S}(\overline{R} + R) + P.Q.S(\overline{R} + R)$ $X = \overline{P}.\overline{Q}.\overline{S} + P.Q.S$ // $\overline{P}.\overline{Q}.\overline{S}(1) + P.Q.S(1)$	**2**

Question	Answer	Marks
5(a)	• X is not a variable • := should be = for an assignment statement • 5 is not a valid digit	**3**
5(b)	<assignment_statement> ::= <variable> = <variable><operator><variable> 1 |<variable> = <variable><operator><unsigned_integer> 1 <variable> ::= <letter><letter> 1 <unsigned_integer> ::= <digit>|<digit><digit> 1 <digit>::= 1 | 2 | 3 <operator> ::= + | - | * 1	**5**

Question	Answer	Marks
5(c)(i)	 or  • two letters **and** two digits / one unsigned integer **and** arrows in and out seen • allows for one or two letters at start • zero, one or two digits // zero or one unsigned integer at end	**3**

5(c)(ii)	**Three** marks for completely correct
	Two marks for four alternatives correct
	One mark for three alternatives correct
	`<variable> ::= <letter>`
	`| <letter><digit>`
	`| <letter><digit><digit>`
	`| <letter><letter>`
	`| <letter><letter><digit>`
	`| <letter><letter><digit><digit>`
	
	Or
	
	Three marks for completely correct
	Two marks for three alternatives correct
	One mark for two alternatives correct
	`<variable> ::= <letter>`
	`| <letter><unsigned integer>`
	`| <letter><letter>`
	`| <letter><letter><unsigned integer>`
		3

Question	Answer	Marks
6(a)(i)	Any **four** from: • Asymmetric encryption / cryptography uses a matching pair of keys • A public key (available to everyone) • … **receiver's** public key used for encrypting the message before it is sent • A private key (only known to the owner of the keys) • … **receiver's** private key for decrypting the message after it has been received	**4**
6(a)(ii)	Any **two** from: • Increased message security as one key is private • Allows message authentication • Allows non-repudiation • Detects tampering	**2**

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Question	Answer	Marks
6(b)(i)	Any **four** from: • A protocol with two layers • …Handshake and Record • A TLS/digital/public key certificate is used for authentication • Handshake uses asymmetric cryptography • … to generate agreed parameters • … establish a shared session key • The shared session key provides symmetric cryptography for • … sending and receiving data (record layer) • At end of session all parameters, keys, etc. erased	**4**
6(b)(ii)	Any **two** from: • Browsers accessing secure websites e.g. bank transactions • VPNs • Email • VOIP	**2**

Question	Answer	Marks
7(a)(i)	Control	**1**
7(a)(ii)	Any **two** from: • **Automatically controls** devices / heaters / air conditioning units • … using actuators • With the use of feedback // output affects the values that are input • To maintain the required temperature range	**2**
7(b)	(Container) 1: 9 degrees (Container) 4: –2 degrees	**2**
7(c)	300 | **1** | **1** | **0** | **0** | **0** | **0** | **0** | **0** |	**1**
7(d)(i)	**One mark** per point • Load the accumulator with status of heaters and air conditioning units // Load the accumulator with the contents of address 300 / • Mask out the bits for container 1 // Mask out 4th and 8th bit • See whether both heater is on and the air conditioning is on // Compare the contents of the accumulator/previous result with B10001000 / (&88) • IF the heater is on and the air conditioning is on / jump to ERROR routine // jump to ERROR routine if bit patterns are equal	**4**

Question	Answer	Marks

7(d)(ii)	**One mark** keeping instructions 1 and 4 the same
	One mark `AND &11`
	One mark `CMP &11`
	
	`LDD 300`
	`AND &11 // AND B00010001`
	`CMP &11 // CMP B00010001`
	`JPE ERROR`
		3