Cambridge Assessment International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9618/31**

Paper 31 Advanced Theory **May/June 2022**

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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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.

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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)	`LibraryBook.Title ← "A Level Computer Science"` `LibraryBook.Fiction ← FALSE`	**2**
1(b)(i)	`DECLARE NumberOfCopies : 1 .. 10`	**1**
1(b)(ii)	`DECLARE AccessionNumber : ARRAY[1:NumberOfCopies] OF INTEGER`	**2**
1(c)	Any **two** from • A data type constructed by a **programmer** // not a primitive data type • A data type that references at least one other data type… • … the data types can be primitive, or user defined **One** mark for an example • Class / object / set	**3**

Question	Answer	Marks
2(a)	`type(caracal, wild).` `hair(caracal, short).`	**2**
2(b)	`persian`	**1**
2(c)(i)	`type(Pet, domestic).`	**1**
2(c)(ii)	`spots(WildSpotty, yes)` `,type(WildSpotty, wild).`	**2**

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Question	Answer	Marks
3	Circuit switching max **four** marks Any **two** from • a dedicated circuit • circuit is established before transmission starts // circuit is released after transmission ends • data is transferred using the whole bandwidth • all data is transferred over the same route **Two** from • Advantage – data /frames arrive in order and do not need to be reassembled • Disadvantage – nobody else can use the same circuit even if it is idle //less secure as only one route used Packet switching max **four** marks Any **two** from • data is split into packets • each packet is given its own route • the routing for a packet depends on the congestion • packets may not arrive in the order sent **Two** from • Advantage – packets can be rerouted if there are problems// more secure as harder to intercept messages • Disadvantage – time taken to reassemble packets at the destination	**8**

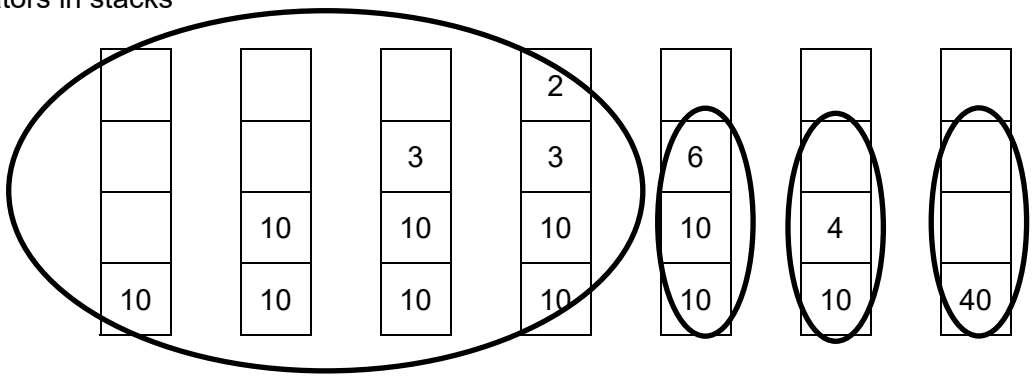
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Question	Answer	Marks
4(a)	RISC **max 2** any **two** from: • Uses simple instructions • Uses fixed length instructions • Instructions only require one clock cycle • Uses many registers • Makes use of pipelining • Hardwired CU CISC **max 2** any **two** from: • Uses many **instruction formats** • Uses variable length instructions • Makes use of different addressing modes • Uses few registers • Has a large instruction set • Requires **complex circuits** • Frequently uses cache • Instructions (converted to sub-instructions that) may require many clock cycles • Programmable CU	**4**
4(b)	**One mark** for each difference **max 2** from: • RISC has fewer instructions // CISC has more instructions • RISC has many registers // CISC has few registers • RISC's instructions are simpler // CISC's instructions are more complex • RISC has a few instruction formats / CISC has many instruction formats • RISC usually uses single-cycle instructions// CISC uses multi-cycle instructions • RISC uses fixed-length instructions // CISC uses variable-length instructions • RISC has better pipelineability // CISC has poorer pipelineability • RISC requires less complex circuits// CISC requires more complex circuits • RISC has fewer addressing modes // CISC has more addressing modes • RISC makes more use of RAM// CISC makes more use of cache/less use of RAM • RISC has a hard-wired control unit // CISC has a programmable control unit • RISC only uses load and store instructions to address memory // CISC has many types of instructions to address memory	**2**

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Question	Answer	Marks

5(a)	**One mark** for each in order `jk+jk-/`
	`jk+`
	`jk-/`
		2

5(b)(i)	**1 mark** per ring Do not allow operators in stacks 	**4**
5(b)(ii)	Any **four** from **Max 4** **Max 3** generic answer only • Working from left to right in the expression • PUSH 10/m onto the stack • PUSH the following numbers (10/m, 3/j, 2/k) onto the stack • When the first operator ,*, is reached • … POP the top two numbers, 2/k and 3/j • … apply the operation • PUSH result back onto stack • Continue to the end of the expression	**4**
5(c)	Any **two** from • recursion • implementation of ADTs e.g. linked lists • procedure calls • interrupt handling (storing contents of registers etc)	**2**

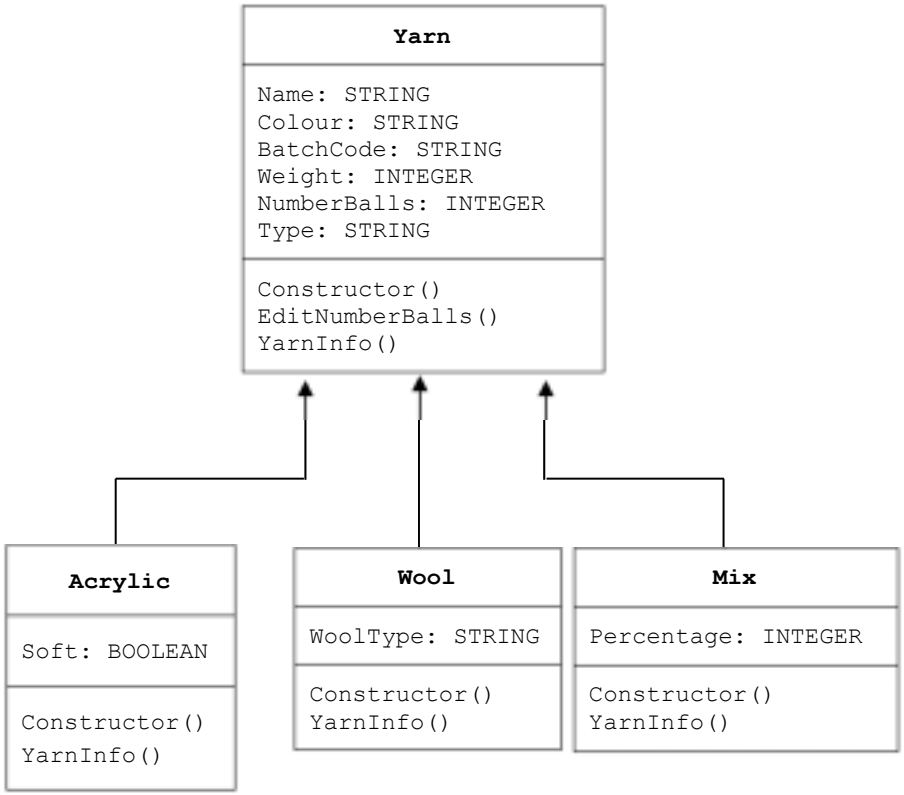
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Question	Answer	Marks
6	**Two** marks each benefit description **max 4** New system can be tried on different virtual hardware (1) without need to purchase the hardware (1) Easier to recover if software emulating the new computer causes system crash (1) as VM provides protection to other software (1) Emulate programs for the new computer system that are not compatible with the host computer / operating system (1) by using the guest operating system on the old computer (1) More than one new computer system can be emulated (1) this allows multiple operating systems to coexist on a single computer(1) **Two** marks each limitation description **max 2** from: Virtual machines may not be able to emulate the new hardware (1) because this hardware may have been developed since the virtual machine was developed (1) Using virtual machine means execution of extra code // A virtual machine might not be as efficient // resources e.g. memory or processor time are shared (1) processing time increased // performance degrades (1) Use of a virtual machine increases the maintenance overheads (1) because both host system and the virtual machine must be maintained (1)	**6**

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Question	Answer	Marks

7(a)	**1 mark** per point
	`Acrylic` has attribute `Soft` of type `BOOLEAN`
	`Wool` has attribute `WoolType` with suitable data type
	`Acrylic` **and** `Wool` have method `YarnInfo()`
	`Acrylic`, `Wool` and `Mix` **at least one** inherit (one arrow correct) from `Yarn` …
	… `Acrylic`, `Wool` and `Mix` **all** inherit (all arrows correct) from `Yarn`
		5



Question	Answer	Marks
7(b)	Properties **max 2**: • the data items / attributes • the data types // characteristics • defined in a class Methods **max 2**: • the procedures/ functions / programmed instructions in a class / super class / base class • … implementing the behaviours • … that act on the properties / attributes Inheritance **max 2**: • Methods and properties / attributes contained in one class/ super class / base class • Are made available to / reused by another class/ derived class	**6**

Question	Answer	Marks
8(a)(i)	Any **two** from • To ensure the message is authentic // came from a trusted source • To ensure that only the intended receiver is able to **understand** the message • To ensure the message has not been altered **during transmission** • Non-repudiation, neither the sender or receiver can deny the transmission occurred	**2**
8(a)(ii)	Symmetric Asymmetric	**2**
8(b)(i)	Any **two** from • Any eavesdropping can be identified (as the state will be changed) • Integrity of the key once transferred can be guaranteed (cannot be copied and decrypted at a later date) • Longer/more secure keys can be exchanged	**2**
8(b)(ii)	Any **two** from • Limited range • requires dedicated fibre (optic) line and specialist hardware • cost of dedicated fibre (optic) line and specialist hardware is expensive • polarisation of light may be altered whilst travelling down fibre optic cables	**2**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>9(a)</td><td>LDM #500: Immediate 500
LDD 500: Direct 100
LDI 500: Indirect 20</td><td>3</td></tr>
<tr><td>9(b)</td><td>
<table>
<tr><th rowspan="2">Label</th><th colspan="2">Instruction</th></tr>
<tr><th>Opcode</th><th>Operand</th></tr>
<tr><td></td><td>LDM</td><td>#20</td></tr>
<tr><td></td><td>STO</td><td>Twenty</td></tr>
<tr><td></td><td>LDI</td><td>Y</td></tr>
<tr><td></td><td>ADD</td><td>Twenty</td></tr>
<tr><td></td><td>STO</td><td>Z</td></tr>
<tr><td>Twenty:</td><td>#20</td><td></td></tr>
<tr><td>Y:</td><td></td><td></td></tr>
<tr><td>Z:</td><td></td><td></td></tr>
</table>
One mark for LDM #20 seen
One mark for storing 20 at any address
One mark for labelling that address e.g. Twenty away from the program code
One mark for labelling addresses away from the program code as Y and Z
One mark for correct use of LDI Y
One mark for correct use of STO Z
One mark for correct use of ADD with labelled address
</td><td>7</td></tr>
</table>

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