Cambridge Assessment International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9618/32**

Paper 3 Problem Solving & Programming **October/November 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)	**Mantissa**: 0 1 1 1 1 1 1 1 1 1 1 **Exponent**: 0 1 1 1 1	**1**
1(b)	**Two** marks for working • correct calculation of exponent seen • correct application of exponent to mantissa seen **One** mark for correct answer Working: = 1.0110010011×2^9 //exponent = 9 = 1011001001.1 (moving bp 9 places to right) // evaluate two's complement For example: –512 + 128 + 64 + 8 + 1 + 0.5 Answer: –310.5 // $-310^1/_2$	**3**
1(c)	**One** mark per point • Following an arithmetic/logical operation • … the result is too small to be precisely represented in the available system // When the number of bits is not enough / too small for the computer's allocated word size / to represent the binary number	**2**

Question	Answer	Marks
2(a)	**One** mark per point • Code generation • Optimisation	**2**

Question	Answer	Marks
2(b)	**One** mark per point (**Max 2**) • It checks that the code matches the grammar of the language // It checks that the tokens conform with the rules of the programming language • **Syntax errors** are reported • A parse tree is produced.	**2**

Question	Answer	Marks
3(a)	**One** mark per point (**Max 2**) • Protocols set a standard for communication • Protocols enable communication/compatibility between devices from different manufacturers/platforms • If two devices were sending messages to each other but using different protocols, they would not be able to communicate properly	**2**
3(b)	**One** mark for each correct answer **Application (Layer)** *Transport* **Internet/Network (Layer)** *Link*	**2**
3(c)	**One** mark per point (**Max 2**) • used by email clients to **retrieve** email messages // a pull protocol • from a mail server (over a TCP/IP connection) • keeps the server and client in sync (by not deleting the original email). // allows a copy of the email to be downloaded from the mail server.	**2**

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Question	Answer	Marks
4(a)	Marks as shown in the square brackets: `TYPE Aircraft = (C300, C350, D242, E757, X380)` `TYPE Aircraft =` [1] `(C300, C350, D242, E757, X380)` [1]	**2**

4(b)	**One** mark for each point (**Max 4**)
	
	• `TYPE Flight` and `ENDTYPE` correct
	• `DECLARE FlightNumber` and `DECLARE Destination` as `STRING`
	• `DECLARE DepartureDate` as `DATE`
	• `DECLARE AircraftType` as `Aircraft` (correct data type from **part 4(a)**)
	
	Example answer:
	
	`TYPE Flight`
	`  DECLARE FlightNumber : STRING`
	`  DECLARE Destination : STRING`
	`  DECLARE DepartureDate : DATE`
	`  DECLARE AircraftType : Aircraft`
	`ENDTYPE`
		4

4(c)(i)	Example answer: `DECLARE Flight1 : Flight`	**1**

Question	Answer	Marks

4(c)(ii)	**One** mark for each point (**Max 3**)
	
	• Correct assignments of both string data values
	• Correct assignments of date data value
	• Correct assignments of enumerated data value
	
	Example answer:
	
	`Flight1.FlightNumber ← "XA782"`
	`Flight1.Destination ← "Cambridge"`
	`Flight1.DepartureDate ← 12/12/2022`
	`Flight1.AircraftType ← C350`
		3

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Question	Answer	Marks
5	**One** mark for each description (**Max 2**) • The emulation of a computer system / hardware and/or software • … using a host computer system. • Using guest operating system(s) for emulation. **One** mark for each correct benefit (**Max 2**) • Multiple guest operating systems / VMs can be used on the same computer. • Different instruction set architectures can be emulated on a single computer. • A virtual machine can crash without affecting the host machine. • There are security benefits // Trying a piece of suspicious software and if it is / has a virus, it will only infect the virtual machine. • Cost savings due to not needing to purchase extra hardware. • Can run legacy applications that are currently incompatible. **One** mark for each correct drawback (**Max 2**) • A virtual machine is less efficient / has poorer performance than real machines **because of extra load on the host computer** • Performance of the guest system cannot be adequately measured. • A virtual machine may be affected by any weaknesses of the host machine. • Costly and/or complex **to maintain / implement / manage**. • Cannot emulate some hardware.	**6**

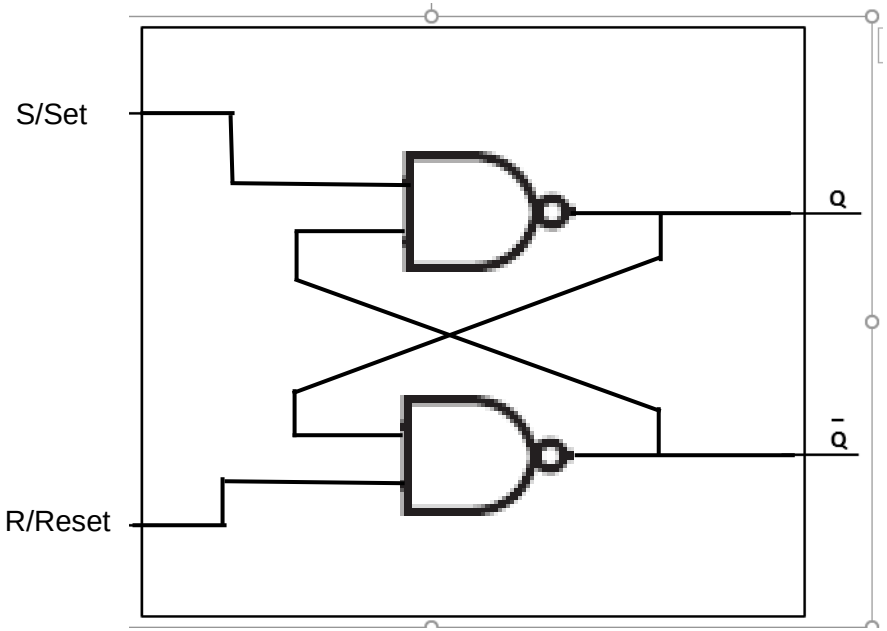
Question	Answer	Marks
6(a)	**One** mark for each point • Symmetric encryption uses a single key and asymmetric encryption uses a pair of keys. • The symmetric single key is used by all, whereas only one of the keys for asymmetric encryption is available to everyone / one of the asymmetric encryption keys needs to be kept secret.	**2**

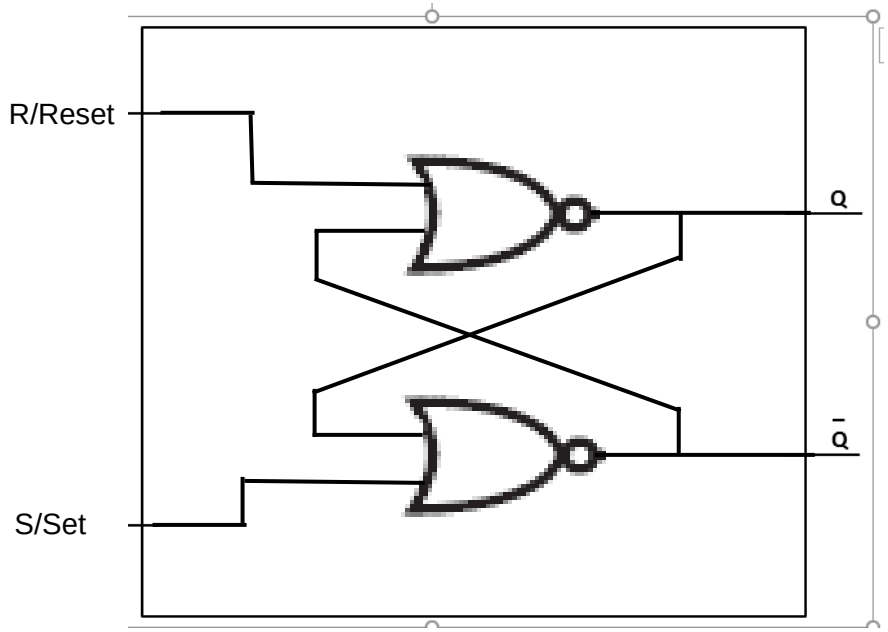
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Question	Answer	Marks
6(b)	**One** mark for each point (**Max 4**) • The organisation requests a certificate from a Certificate Authority (CA) • The organisation may send their public key to CA • The organisation gathers all the information required by the CA in order to obtain their certificate, which includes information to prove their identity • The CA verifies the organisation's identity • The CA generates / issues the certificate including the organisation's public key (and other information).	**4**

Question	Answer	Marks
7	**One** mark for each point Supervised learning (**Max 3 of 4**) • Supervised learning allows data to be collected, or a data output produced, from the previous experience. • In supervised learning, known input and associated outputs are given // uses sample data with known outputs (in training) // uses labelled input data. • Able to predict future outcomes based on past data. Unsupervised learning (**Max 3 of 4)** • Unsupervised machine learning helps all kinds of unknown patterns in data to be found. • Unsupervised learning only requires input data to be given. • Uses any data // not trained on the right output // uses unlabelled input data.	**4**

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Question	Answer	Marks
8(a)	**One** mark for each point (**Max 4**) • One correct NAND or NOR gate with two separate inputs and one output • Second correct logic gate of same type as first with two separate inputs and one output • Correct connections between logic gates • Correctly labelled inputs Example answers:  	**4**

Question	Answer	Marks
8(a)	**Or**  	
8(b)	To store a binary digit / (single) bit.	**1**

Question	Answer	Marks
8(c)	**One** mark for each point (**Max 3**) • Correct application of De Morgan's Law • Correct application of Double Negation Law or Distributive Law • Correct answer $\overline{\overline{A}\,\overline{B}}.\overline{(A.C)}.\overline{(B.D)}$ $\overline{\overline{A}\,\overline{B}} + \overline{(A.C)} + \overline{(B.D)}$ [1] $(\overline{A}.\overline{B}) + (\overline{A.C}) + (B.D)$ [1] $\overline{A}.\ (\overline{B} + C) + B.D$ [1]	**3**

Question	Answer	Marks
9(a)	**One** mark for each point (**Max 3**) • Process scheduling allows more than one program/task to appear to be executed at the same time / enables multi-tasking / multiprogramming. • To allow high priority jobs to be completed first. • To keep the CPU busy all the time • … to ensure that all processes execute efficiently • … and to have reduced wait times for all processes / to ensure all processes have fair access to the CPU / prevent starvation of some processes.	**3**

Question	Answer	Marks
9(b)	**One** mark for each point (**Max 2**) for **Shortest job first**: • Process are executed in ascending order of the amount of CPU time required // Short processes are executed first **and** followed by longer processes. • …which leads to an increased throughput (because more processes can be executed in a smaller amount of time). **One** mark for each point (**Max 2**) for **Round robin**: • Each process is served by the CPU for a fixed time/time slice (so all processes are given the same priority). • Starvation doesn't occur (because for each round robin cycle, every process is given a fixed time/time slice to execute). **One** mark for each point (**Max 2**) for **First come first served**: • No complex logic, each process request is queued as it is received and executed one by one. • Starvation doesn't occur (because every process will eventually get a chance to run) // less processor overhead.	**6**

Question	Answer	Marks
10(a)	**One** mark for each correct OOP term definition • Encapsulation – putting properties and methods inside a class // ensures sensitive data is hidden from users by hiding values of a structured data object inside a class. • Getter – method that is used to return the value of a property. • Setter – method that is used to update the value of a property.	**3**

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Question	Answer	Marks
10(b)	**One** mark for each point • properties correct • setters correct • getters correct **SubstituteTeacher** SubName : STRING **Telephone : STRING** InSchool : BOOLEAN **SetSubName(StaffName : STRING)** SetTelephone(Tel : STRING) **SetInSchool(Present : BOOLEAN)** GetSubName() **GetTelephone()** **GetInSchool()**	**3**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>11(a)</td><td>

One mark for each point

- Correct `HeadPointer`
- Any three correct `NextPointer`
- All six `NextPointer` correct

`HeadPointer` | 5

Index	Flower	NextPointer
1	Rose	0
2	~~Marigold~~	
3	Foxglove	4
4	Iris	9
5	Daisy	3
6	~~Dahlia~~	
7	~~Saxifrage~~	
8	Lupin	1
9	Lily	8
10	~~Hydrangea~~	

</td><td>**3**</td></tr>
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Question	Answer	Marks

11(b)	**One** mark for each correct line
	
	`Pointer ← HeadPointer`
	`Found ← 0`
	`OUTPUT "Enter a flower name "`
	`INPUT FlowerName`
	`WHILE Pointer <> 0`
	`  IF Flower[Pointer] = FlowerName THEN`
	`  Found ← Pointer`
	`  Pointer ← 0`
	`  ELSE`
	`  Pointer ← NextPointer[Pointer]`
	`  ENDIF`
	`ENDWHILE`
	`IF Pointer = 0 THEN // IF Found <> 0 THEN`
	`  OUTPUT Flower[Found], " is found"`
	`ELSE`
	`  OUTPUT "The flower you wanted is not in the list"`
	`ENDIF`
		5

11(c)	**One** mark for each point (**Max 2**) • Include a free list pointer • …to reuse the unused space • …as a linked list of free space.	**2**