GCE

Computer Science

H046/02: Algorithms and problem solving

AS Level

Mark Scheme for June 2023

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

RM ASSESSOR

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM Assessor Assessor Online Training*; *OCR Essential Guide to Marking*.

2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal http://www.rm.com/support/ca

3. Log-in to RM Assessor and mark the **required number** of practice responses ("scripts") and the **number of required** standardisation responses.

   YOU MUST MARK 10 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

MARKING

1. Mark strictly to the mark scheme.

2. Marks awarded must relate directly to the marking criteria.

3. The schedule of dates is very important. It is essential that you meet the RM Assessor 50% and 100% (traditional 40% Batch 1 and 100% Batch 2) deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM Assessor messaging system, or by email.

5. **Crossed Out Responses**
   Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

   Rubric Error Responses – Optional Questions
   Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

   Multiple Choice Question Responses
   When a multiple choice question has only a single, correct response and a candidate provides two responses (even if one of these responses is correct), then no mark should be awarded (as it is not possible to determine which was the first response selected by the candidate).
   When a question requires candidates to select more than one option/multiple options, then local marking arrangements need to ensure consistency of approach.

   Contradictory Responses
   When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

   Short Answer Questions (requiring only a list by way of a response, usually worth only **one mark per response**)
   Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

Short Answer Questions (requiring a more developed response, worth **two or more marks**)
If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

Longer Answer Questions (requiring a developed response)
Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

6. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there, then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
   • there is nothing written in the answer space

   Award Zero '0' if:
   • anything is written in the answer space and is not worthy of credit (this includes text and symbols).

   Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM Assessor **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**
   If you have any questions or comments for your team leader, use the phone, the RM Assessor messaging system, or e-mail.

9. *Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.*

10. For answers marked by levels of response: Not applicable in F501
    a. **To determine the level** – start at the highest level and work down until you reach the level that matches the answer
    b. **To determine the mark within the level**, consider the following

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

1. Annotations

Annotation	Meaning
∧	Omission mark
BOD	Benefit of the doubt
✖	Incorrect point
E	Expansion of a point
FT	Follow through
NAQ	Not answered question
NBOD	No benefit of doubt given
P	Point being made
REP	Repeat
✔	Correct point
TV	Too vague
0	Zero (big)
BP	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
L1	Level 1
L2	Level 2
L3	Level 3

   2. Subject - specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:
- the specification, especially the assessment objectives
- the question paper and its rubrics
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet Instructions for **Examiner**s. If you are examining for the first time, please read carefully Appendix 5 Introduction to Script Marking: **Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

USING THE MARK SCHEME

Please study this Mark Scheme carefully. The Mark Scheme is an integral part of the process that begins with the setting of the question paper and ends with the awarding of grades. Question papers and Mark Schemes are developed in association with each other so that issues of differentiation and positive achievement can be addressed from the very start.

This Mark Scheme is a working document; it is not exhaustive; it does not provide 'correct' answers. The Mark Scheme can only provide 'best guesses' about how the question will work out, and it is subject to revision after we have looked at a wide range of scripts.

The Examiners' Standardisation Meeting will ensure that the Mark Scheme covers the range of candidates' responses to the questions, and that all Examiners understand and apply the Mark Scheme in the same way. The Mark Scheme will be discussed and amended at the meeting, and administrative procedures will be confirmed. Co-ordination scripts will be issued at the meeting to exemplify aspects of candidates' responses and achievements; the co-ordination scripts then become part of this Mark Scheme.

Before the Standardisation Meeting, you should read and mark in pencil a number of scripts, in order to gain an impression of the range of responses and achievement that may be expected.

In your marking, you will encounter valid responses which are not covered by the Mark Scheme: these responses must be credited. You will encounter answers which fall outside the 'target range' of Bands for the paper which you are marking. Please mark these answers according to the marking criteria.

Please read carefully all the scripts in your allocation and make every effort to look positively for achievement throughout the ability range. Always be prepared to use the full range of marks.

LEVELS OF RESPONSE QUESTIONS:

The indicative content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using 'best-fit', decide first which set of BAND DESCRIPTORS best describes the overall quality of the answer. Once the band is located, adjust the mark concentrating on features of the answer which make it stronger or weaker following the guidelines for refinement.

- **Highest mark**: If clear evidence of all the qualities in the band descriptors is shown, the HIGHEST Mark should be awarded.
- **Lowest mark**: If the answer shows the candidate to be borderline (i.e. they have achieved all the qualities of the bands below and show limited evidence of meeting the criteria of the band in question) the LOWEST mark should be awarded.
- **Middle mark**: This mark should be used for candidates who are secure in the band. They are not 'borderline' but they have only achieved some of the qualities in the band descriptors.

Be prepared to use the full range of marks. Do not reserve (e.g.) high Band 3 marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the band descriptors, reward appropriately.

	AO1	AO2	AO3
High (thorough)	Precision in the use of question terminology. Knowledge shown is consistent and well-developed. Clear appreciation of the question from a range of different perspectives making extensive use of acquired knowledge and understanding.	Knowledge and understanding shown is consistently applied to context enabling a logical and sustained argument to develop. Examples used enhance rather than detract from response.	Concerted effort is made to consider all aspects of a system/problem or weigh up both sides to an argument before forming an overall conclusion. Judgements made are based on appropriate and concise arguments that have been developed in response resulting in them being both supported and realistic.
Middle (reasonable)	Awareness of the meaning of the terms in the question. Knowledge is sound and effectively demonstrated. Demands of question understood although at times opportunities to make use of acquired knowledge	Knowledge and understanding applied to context. Whilst clear evidence that an argument builds and develops through response there are times when opportunities are missed to use an example or relate an aspect	There is a reasonable attempt to reach a conclusion considering aspects of a system/problem or weighing up both sides of an argument. However the impact of the conclusion is often lessened by a lack of supported

	and understanding not always taken.	of knowledge or understanding to the context provided.	judgements which accompany it. This inability to build on and develop lines of argument as developed in the response can detract from the overall quality of the response.
Low (basic)	Confusion and inability to deconstruct terminology as used in the question. Knowledge partial and superficial. Focus on question narrow and often one-dimensional.	Inability to apply knowledge and understanding in any sustained way to context resulting in tenuous and unsupported statements being made. Examples if used are for the most part irrelevant and unsubstantiated.	Little or no attempt to prioritise or weigh up factors during course of answer. Conclusion is often dislocated from response and any judgements lack substance due in part to the basic level of argument that has been demonstrated throughout response.

	Assessment Objective
AO1	Demonstrate knowledge and understanding of the principles and concepts of computer science, including abstraction, logic, algorithms and data representation.
AO1.1	Demonstrate knowledge of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO1.2	Demonstrate understanding of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO2	Apply knowledge and understanding of the principles and concepts of computer science including to analyse problems in computational terms.
AO2.1	Apply knowledge and understanding of the principles and concepts of computer science.
AO2.2	Analyse problems in computational terms.
AO3	Design, program and evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.
AO3.1	Design computer systems that solve problems.
AO3.2	Program computer systems that solve problems.
AO3.3	Evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.

Question			Answer/Indicative content	Mark	Guidance
1	a		1 mark per bullet • 1st swap of 5 and 3 • Remainder of first pass • Pass 2 • Pass 3 (see table below) 	4	Candidates do not need to show each swap, so if the candidate has clearly shown the end of pass 1, they have met the first two marking points. Marks can be awarded for correctly showing the results of each pass.
1	b	i	1 mark per bullet • by reference will reorder the contents of the array • …so the new order can be accessed by the main program // so will be saved when the procedure ends • by value will change the array only in this procedure • … and so would need to return the array.	3	
1	b	ii	• A loop that repeats a fixed / set number of times	1	
1	b	iii	• To temporarily hold a value (for numbers[x])… • …while it is being transferred from one position to another… • ….in the array numbers • To stop values over writing each other	3	

For question 1 a, the array table:

1	5	3	9	2	7	
1	**3**	**5**	9	2	7	
1	3	5	**2**	**9**	7	
1	3	5	2	**7**	**9**	End of pass 1
1	3	2	5	7	9	End of pass 2
1	2	3	5	7	9	End of pass 3

1	b	iv	• Add a (second outer) loop • That will repeat for each pass // repeat until the flag is set to true at the end of a pass	**2**	
1	c	i	• 355	**1**	
1	c	ii	• Insertion sort	**1**	Accept any valid sorting algorithm e.g. Merge sort, Quick sort

2	a		1 mark per bullet to max 3 Any reasonable abstraction e.g. • will not be to scale not life size • will exclude features e.g. people, road markings etc • will only show what is relevant e.g. buildings	**3**	
2	b	i	1 mark per bullet e.g. • stage (e.g. stage 1, stage 2, stage 3) • city name (e.g. London) • speed (e.g. slow, normal, fast)	**2**	
2	b	ii	1 mark per bullet to max 2, e.g. • Does the build-up stage need to be shown? • Does the earthquake taking place needs to be shown? • Does the aftershock stage needs to be shown?	**2**	Allow other suitable examples
2	c	i	1 mark per bullet to max 4, e.g. • spiral works on a small set of requirements… • …waterfall starts with all requirements • spiral repeats from the start of the cycle each time… • …waterfall to repeat needs to reverse through previous stages first • Spiral focuses on risk mitigation… • … Waterfall focuses on the delivery of the project as a whole.	**4**	Max 2 marks if no explicit differences identified between the models.

2	c	ii	1 mark e.g.
			   • The client needs the program quickly
			   • The client wants to be heavily involved
			   • The project is only small
			   • The project is low risk
				2	

2	c	iii	1 mark for name 1 mark for description
			e.g.
			   • agile/rapid application development
			   • building/use of prototypes
			
			   • extreme programming
			   • type of agile // has subsequent releases of new features
				2	Accept any sensible methodology and description,

| 3 | | | **Mark Band 3–High Level**
(7-9 marks)
The candidate demonstrates thorough knowledge and understanding of IDEs; the material is generally accurate and detailed.
The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.
The candidate provides a thorough discussion which is well-balanced. Evaluative comments are consistently relevant and well-considered.
There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.

Mark Band 2-Mid Level
(4-6 marks)
The candidate demonstrates reasonable knowledge and understanding of IDEs; the material is generally accurate but at times underdeveloped.
The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.
The candidate provides a reasonable discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.
There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence. | 9 | **AO1: Knowledge and Understanding**
e.g.
IDE:
• pretty print / syntax highlighting
• auto-complete
• auto-correction
• breakpoints
• stepping
Editor:
• no helpful writing/debugging features
• no excess features/interface

AO2.1: Application
e.g.
IDE
• identify syntax errors as writing
• …saves trying to find them
• easier debugging as can step through a program
• auto-indenting avoids errors from incorrect indentation
• May have built in unit testing to automate testing and avoid new errors being introduced.
Editor
• does not offer suggestions on code corrections
• Has a lower footprint on memory/CPU which may be suited to quick alterations or working on lowed spec'd systems.
• May be better when learning to program as it forces the user to type everything in full / doesn't give suggestions, helping things stick in memory.

AO3.3: Evaluation
e.g.
• IDE is helpful in reducing original errors
• IDE is helpful in finding and correcting errors |

			Mark Band 1-Low Level **(1-3 marks)** The candidate demonstrates a basic knowledge of IDEs, with limited understanding shown; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. **0 marks** No attempt to answer the question or response is not worthy of credit.		• Editor is a simpler system to use e.g. less memory needed to run it, does not try and auto-correct incorrectly or introduce errors that the programmer has not made.

| 4 | a | | 1 mark per bullet to max 6
• function header taking parameter
• looping appropriately e.g. until value is 0
• dividing by 2 and finding remainder e.g. MOD
• adding 1 or 0 correctly
• …appending to a value to be returned // final string reversed
• reducing value to use within loop
• returning calculated value

e.g.
`function toBinary(denary)`
`  binaryValue=""`
`  while denary > 0`
`    temp = denary MOD 2`
`    if temp == 1 then`
`      binaryValue = "1" + binaryValue`
`    else`
`      binaryValue = "0" + binaryValue`
`    endif`
`  denary = denary DIV 2`
`  endwhile`
`  return binaryValue`
`endfunction` | **6** | Award a recursive algorithm as equivalent |

| 4 | b | | 1 mark per bullet to max 4
   • taking value as input
   • looping until valid between 1 and 255
   • calling function with correct parameter
   • outputting return value

```
denary = -1
while denary < 1 or denary > 255
  denary = input("Enter denary value between 1 and 255")
endwhile
print(toBinary(denary))
``` | 4 | Allow other checks for a valid number. For example

`denary.isInteger == False` |

5	a	i	• sequence	1	
5	a	ii	• selection // branching	1	

5	b		1 mark each to max 2
			  • total
			  • smallest
			  • largest
			  • x
			  • dataArray
				2	

5	c		1 mark for each line and correction
			  • Line 01
			    `total = 0`
			  • Line 02
			    `smallest = dataArray[0]`
			  • Line 04
			    `for x = 0 to 19` (accept 20)
			  • Line 07
			    `if dataArray[x] > largest then`
			  • Line 14
			    `print("Average = " + total / 20)`
				4	Do not award a mark for the line number alone without correction.

5	d	i	it can only be accessed within the subroutine//block in which it is declared	1	

5	d	ii	1 mark for benefit
			e.g.
			  • Increases data integrity
			  • More efficient memory usage
			  • Stops other subroutines accidently altering variable
			
			1 mark for drawback
			e.g.
			  • Cannot be accessed directly by other subroutines
			  • It has to be passed into a subroutine as a parameter
				2	

6	a	i	1 mark per bullet - Start with the first element - Compare it to the number input - If it is equal, return the index // True - If not equal, move to the next element and repeat - Repeat until it is found, or the end of the array is reached - If found, return the index where the data was found - If the end of the list was reached, return -1 // False // "not found" message	**5**	
6	a	ii	1 mark per bullet - If the data is not in any order // binary search requires the data to be in order - When the number of items to search is small	**1**	
6	b		1 mark per bullet to max 4 (Stack) Pointer points to the last element added to the stack / top of the stack - New data is added to the pointer position // pointer+1… …check for overflow condition …pointer is then incremented - Data is removed from pointer/pointer-1 position… …check for underflow condition …pointer is then decremented - Elements can be accessed through Push() and Pop() methods that are implemented	**4**	Note: Answers must relate to an array implementation which means that a stack pointer must be implemented.

Need to get in touch?

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