GCE A LEVEL MARKING SCHEME

SUMMER 2024

A LEVEL
COMPUTER SCIENCE - COMPONENT 1
A500U10-1

About this marking scheme

The purpose of this marking scheme is to provide teachers, learners, and other interested parties, with an understanding of the assessment criteria used to assess this specific assessment.

This marking scheme reflects the criteria by which this assessment was marked in a live series and was finalised following detailed discussion at an examiners' conference. A team of qualified examiners were trained specifically in the application of this marking scheme. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners. It may not be possible, or appropriate, to capture every variation that a candidate may present in their responses within this marking scheme. However, during the training conference, examiners were guided in using their professional judgement to credit alternative valid responses as instructed by the document, and through reviewing exemplar responses.

Without the benefit of participation in the examiners' conference, teachers, learners and other users, may have different views on certain matters of detail or interpretation. Therefore, it is strongly recommended that this marking scheme is used alongside other guidance, such as published exemplar materials or Guidance for Teaching. This marking scheme is final and will not be changed, unless in the event that a clear error is identified, as it reflects the criteria used to assess candidate responses during the live series.

GCE A LEVEL COMPUTER SCIENCE

SUMMER 2024 MARK SCHEME

Q	Answer	Mark	AO1	AO2	AO3	Total
1(a)	**Award 1 mark for each correct answer up to a maximum of 4.** A linked list is a dynamic data structure as it can grow and shrink in size after declaration. Each element in a linked list is known as a node, the first element is the head node. Each node consists of the data itself and the address/reference/pointer to the next node. Linked lists do not provide direct or random access to elements which makes them less efficient when searching. Linked lists can be traversed in a sequential manner, starting from the head node, and moving through each node until the end is reached. Linked lists are efficient for inserting and deleting elements at any point in the list / with a time complexity of O (1)	4	1b			4

Q	Answer	Mark	AO1	AO2	AO3	Total
1(b)	**Award 1 mark for each correct answer up to a maximum of 4.** A hash table stores data using a key/value pair. A hashing algorithm is used to generate a key to identify at which location the data can be stored. The MOD operation is commonly used in a hashing algorithm to generate the key. Data can be retrieved using the key to return the value. If the hashing algorithm generates a key that is already present in the hash table problems can occur such as data collision. One solution would be to use separate chaining where a linked list is used to store values of the same key. Overall table linked list Separate chaining could slow the down the overall retrieval of data. Linear probing is another solution that could be used to store the data in the next available location and assign a new key. A good hashing algorithm distributes keys uniformly across the hash table to avoid collision.	4	1b			4

<table>
<tr><th>Q</th><th>Answer</th><th>Mark</th><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th></tr>
<tr><td>1(c)(i)</td><td>Award 1 mark for correct position of <code>Fifth</code>.
Award 1 mark for correct removal of <code>Sixth</code>.

<table><tr><th>Key</th><th>Value</th></tr><tr><td>Fourth</td><td>40</td></tr><tr><td>Third</td><td>60</td></tr><tr><td>Second</td><td>80</td></tr><tr><td>First</td><td>100</td></tr><tr><td>Fifth</td><td>20</td></tr></table>
OR

<table><tr><th>Key</th><th>Value</th></tr><tr><td>Fifth</td><td>20</td></tr><tr><td>Fourth</td><td>40</td></tr><tr><td>Third</td><td>60</td></tr><tr><td>Second</td><td>80</td></tr><tr><td>First</td><td>100</td></tr></table></td><td>2</td><td></td><td>2a</td><td></td><td>2</td></tr>
<tr><td>1(c)(ii)</td><td>Award 1 mark for correct name of hash table of <code>scores</code>.
Award 1 mark for correct key of <code>Third</code>.

<code>scores["Third"]</code></td><td>2</td><td></td><td>2a</td><td></td><td>2</td></tr>
<tr><td>2</td><td>Award 1 mark for A AND NOT B
Award 1 mark for NOT A AND B
Award 1 mark for (A AND NOT B) OR (NOT A AND B)
Award 1 mark for A XOR B

Award 1 mark for column A
Award 1 mark for column B
(A AND NOT B) OR (NOT A AND B) = A XOR B

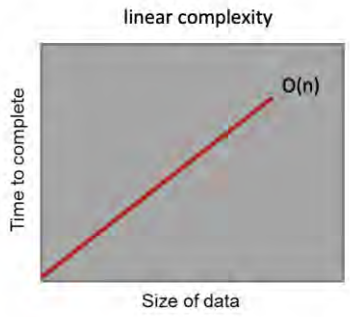
<table><tr><th>A</th><th>B</th><th>NOT A</th><th>NOT B</th><th>A AND NOT B</th><th>NOT A AND B</th><th>(A AND NOT B) OR (NOT A AND B)</th><th>A XOR B</th></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table></td><td>1
1
1
1
1
1</td><td></td><td>2a</td><td></td><td>6</td></tr>
</table>

Q	Answer	Mark	AO1	AO2	AO3	Total
3(a)	**Award 1 mark for each correct answer up to a maximum of 4.** The Data Protection Act 2018 (DPA) is the UK's implementation of the General Data Protection Regulation (GDPR). The DPA applies to any organisation or individual that processes personal data, which includes collecting, storing, using, and sharing data. The DPA gives individuals several rights over their personal data, such as the right to access and remove their data. The DPA requires organisations to obtain explicit consent from individuals in certain cases. The DPA also requires organisations to protect personal data against unauthorised or unlawful processing, accidental loss, destruction, or damage. Organisations that fail to comply with the DPA may be subject to fines and legal action.	4	1b			8
3(b)	**Award 1 mark for each correct answer up to a maximum of 4.** The FOIA gives individuals the right to request information from public authorities. Public authorities include government departments, local authorities, and the National Health Service (NHS). The FOIA sets out a process for requesting information, including a requirement for public authorities to respond within 20 working days. There are exemptions to the FOIA, such as information that would threaten national security or breach someone's privacy. Failure to comply with FOIA can result in legal action and fines, and imprisonment for individuals who destroy or fail to disclose information. Transparency and accountability of the act should increase the openness and accountability of government authorities Information Commissioner's Office (ICO) plays a crucial role in ensuring compliance, providing guidance and handling complaints.	4	1b			

Q	Answer	Mark	AO1	AO2	AO3	Total
4	**Award 1 mark for each correct statement up to maximum of 7.** <letter> ::= "A" | "B" | ... | "Z" | "a" | "b" | ... | "z" <digit> ::= "0" | "1" | ... | "9" <space> ::= " " <string> ::= <letter> | <digit> | <space> | <letter> <string> |<digit> <string> | <space> <string> <field> ::= "artist" | "album" | "song" <operator> ::= "AND" | "OR" | "NOT" <phrase> ::= " <string> " <search-criteria> ::= <field> ": " <phrase> <search> ::= <search-criteria> | <search-criteria> <operator> <search> **All notation correct Award 1 mark**	8		2a		8

Q	Answer	Mark	AO1	AO2	AO3	Total
5 (a)	**Award 1 mark for correct use of De Morgan's** **Correctly applying identities to arrive at correct answer 4 additional marks** **Correctly applying identities but arriving at wrong answer 1 mark for each correct application up to a maximum of 3.** Correct answer can be established using different steps / laws / rules / identities. One possible solution: $A.B + A.(1.C + \overline{C.1})$ $A.B + A.(1.C + \overline{C} + \overline{1})$ *De Morgan's Theorem* $A.B + A.(1.C + \overline{C} + 0)$ *Complement Law* $A.B + A.(1.C + \overline{C})$ *Identity Law* $A.B + A.(C + \overline{C})$ *Complement Law* $A.B + A.1$ *Identity Law* $A.B + A$ *Absorption Law* A	5		2a		10
5 (b)	**Correctly applying identities to arrive at correct answer 5 marks** **Correctly applying identities but arriving at wrong answer 1 mark for each correct application up to a maximum of 4.** Correct answer can be established using different steps / laws / rules / identities. One possible solution: $X.Y + Z.(Y.Z + 0.X + 0)$ $X.Y + Z.(Y.Z + 0.X)$ *Identity Law* $X.Y + Z.(Y.Z + 0)$ *Identity Law* $X.Y + Z.(Y.Z)$ *Distributive Law* $X.Y + Z.Y.Z.Z$ *Idempotent Law* $X.Y + Z.Y.Z$ *Idempotent Law* $X.Y + Z.Y$ OR Y(X+Z)	5		2a		

Q	Answer	Mark	AO1	AO2	AO3	Total
6 (a)	**Award 1 mark for each correct answer up to a maximum of 3.** Translation errors occur during the compilation/interpretation of source code into machine code. Translation errors include syntax errors and logical errors. Syntax errors occur when there is incorrect syntax or spelling mistakes in the source code. For example, in Python, forgetting to add a colon at the end of a function will cause a syntax error. These errors can be mitigated using inbuilt IDE features such as autocomplete and linting. **Accept any suitable example.**	3	1a			6
6 (b)	**Award 1 mark for each correct answer up to a maximum of 3.** Execution errors occur when a program is running and cause unexpected results. Execution errors include runtime errors and system errors. Runtime errors occur when the program is running, and an unhandled exception occurs. For example, if a program tries to divide a number by zero, it will crash or display an error message, These errors can be mitigated using erroring handling such as try catch blocks and testing. **Accept any suitable example.**	3				

Q	Answer	Mark	AO1	AO2	AO3	Total
7(a)	1 mark for identifying 4 instructions executed once outside the loop 1 mark for identifying while loop will execute n times 1 mark for identifying 3 instructions executed in while loop 1 mark for determining that the order will be dominated by n 1 mark for O(3n+4) 1 mark for determining that the growth rate for time performance in Big O notation is O(n)	5			3c	11
7 (b)	Identifying linear complexity Time axis labelled correctly Size axis labelled correctly Correct gradient of line  	4		2a		
7(c)	The algorithm only uses one data structure, a one-dimensional array. Therefore, total storage requirements = 1 As only one data structure is being used, the growth rate for memory will be constant O(1).	2			3c	

Q	Answer	Mark	AO1	AO2	AO3	Total

8	**One mark for each of the following up to a maximum of 9:**
	
	Declaring variables
	Initialise sum and count
	Loop through items to length of array
	Check if value is an odd number (MOD)
	Increment count
	Add value to sum
	Check if any odd values have been found (no divide by 0)
	Calculate average
	Output message(s).
	
	Indicative content
	
	`1 declare myArray[] as integer[]`
	`2 sum is integer`
	`3 count is integer`
	`4 average is real`
	`5`
	`6 set sum = 0`
	`7 set count = 0`
	`8`
	`9 for i = 0 to len(myArray) - 1`
	`10 if myArray[i] MOD 2 <> 0 then`
	`11 set count = count + 1`
	`12 set sum = sum + myArray[i]`
	`13 end if`
	`14 next i`
	`15`
	`16 if count > 0`
	`17 set average = sum /count`
	`18 else`
	`19 set average = 0.0`
	`20`
	`21 output "Count of odd values: " + count`
	`22 output "Sum of odd values: " + sum`
	`23 output "Average of odd values: " + average`
		9		3a		9

Q	Answer	Mark	AO1	AO2	AO3	Total
9(a)	**Award 1 mark for each of the following up to a maximum of 2** Lexical analysis involves breaking down the source code into tokens or lexemes. Each token represents a specific piece of code such as a keyword, identifier or operator. Comments and whitespace are removed during lexical analysis. A symbol table is created which holds the addresses of variables, labels and subroutines.	2	1b			6
9(b)	**Award 1 mark for each of the following up to a maximum of 2** Syntax analysis involves checking the sequence of tokens to see if they meet to the rules of the programming language. If the syntax is valid a parse tree is generated. If the syntax of the code is not valid syntax error messages are produced.	2				
9(c)	**Award 1 mark for each of the following up to a maximum of 2** Semantic analysis involves checking to ensure that variables are declared before they are used Functions are also checked to see if they have the correct number and types of argument. Logical operations are checked to ensure that they are appropriate for the type of variable being used.	2				

Q	Answer	Mark	AO1	AO2	AO3	Total
10	**Award 1 mark for each of the following up to a maximum of 4** Data Flow Diagrams are a graphical representation of the flow of data through a system. Data flow Diagrams use symbols and other notation to show how data moves from one process to another and how that date is stored. Flow charts are a graphical representation of a process or algorithm, including the flow of data. Flow charts use various symbols to show the different steps and decisions in a process and also shows the movement of data through the process. UML is a diagrammatic visual language used to model software systems. UML includes diagrams such as activity diagrams and sequence to show how data flows through a system.	4	1b			4

Q	Answer	Mark	AO1	AO2	AO3	Total
11(a)	**Award 1 mark for each of the following up to a maximum of 4** Constants and variables are used to store and manipulate data in this algorithm. Constants are used to store values that do not change during the run of this algorithm. PI is an example of a constant used in this algorithm. Variables are used to store values that may change during the run of this algorithm. The variables circumference, area, and diameter are examples of variables used in this algorithm. **Accept any suitable examples.**	4		2a		8
11(b)	**Award 1 mark for each of the following up to a maximum of 4** Self-documenting identifiers makes it clear what each variable and constant holds. For example, the variable radius represents the radius of the circle, which is a clear and concise identifier. Using annotation makes the algorithm more readable and easier to understand. For example, the comment {calculate area} clearly identifies this line of code is calculating the area. Using annotation and self-documenting identifiers makes the code easier to maintain and modify in the future. **Accept any suitable examples.**	4				

Q	Answer	Mark	AO1	AO2	AO3	Total
12	**Indicative content** The Waterfall model is a linear, sequential approach to software development. The Waterfall approach involves several stages, including requirements gathering, design, implementation, testing and maintenance. Each stage must be completed before the next one can begin. Once one stage is completed the development team cannot go back. The Waterfall method is commonly used for large, complex projects that require a high degree of planning and documentation. One method of changeover suitable for the Waterfall method direct changeover method. In the direct change over method the old system is completely replaced by the new system. This method of changeover is quick/fast, but it can be risky if there are any issues with the new system. Another suitable method is parallel changeover. The parallel changeover method involves running both the old and new systems simultaneously for a period of time, allowing a business to switch over gradually. This method is less risky than direct changeover but can be more time-consuming and expensive as it requires more resources. Another approach to software development is the Agile methodology, this approach is an iterative and incremental. The Agile approach involves breaking down the project into smaller, manageable pieces called sprints. Each sprint is focused on delivering a specific set of features or aspect of a system.	12	1b			12

Q	Answer	Mark	AO1	AO2	AO3	Total
	The Agile methodology facilitates collaboration, flexibility, and feedback from a development team. This allows for continuous improvement throughout the development process unlike in the Waterfall approach. This could prove much more costly if the number of changes are frequent. One method of changeover suitable for the Agile method is the phased changeover method. The phased changeover method involves rolling out new features and functionality in stages/phases. This allows users and business to gradually adapt to the changes to an existing/new system. This method is less risky than direct changeover but can be more time-consuming and may require more planning. Another suitable method is continuous changeover. In continuous changeover, new features and functionality are released continuously, with updates pushed out as soon as they are ready. This method requires a high degree of collaboration and communication between development teams and end-users.					

Band	Q13 AO1b - Max 12 marks
3	**10 – 12 marks** **The candidate has:** • written an extended response that has a sustained line of reasoning which is coherent, relevant, and logically structured. • shown clear understanding of the requirements of the question and a clear knowledge of the topics as specified in the indicative content. Clear knowledge is defined as responses that provide relevant detailed points, which relate to an extensive amount of the indicative content. • addressed the question appropriately with minimal repetition and no irrelevant material • has presented a balanced discussion and justified their answer with examples • effectively drawn together different areas of knowledge, skills and understanding from all relevant areas across the course of study used appropriate technical terminology confidently and accurately.
2	**5 - 9 marks** **The candidate has:** • written a response that has an adequate line of reasoning with elements of coherence, relevance, and logical structure • shown adequate understanding of the requirements of the question and a satisfactory knowledge of the topics as specified in the indicative content. Satisfactory knowledge is defined as responses that provide relevant points, which relate to the indicative content. • presented a discussion with limited examples • drawn together different areas of knowledge, skills and understanding from a number of areas across the course of study used appropriate technical terminology.
1	**1- 4 marks** **The candidate has:** • written a response that that lacks sufficient reasoning and structure • produced a discussion which is not well developed • attempted to address the question but has demonstrated superficial knowledge of the topics specified in the indicative content. Superficial knowledge is defined as responses that provide limited relevant points, which relate to a limited amount the indicative content. used limited technical terminology.
0	Response is not credit worthy or not attempted.