GCE A LEVEL MARKING SCHEME

SUMMER 2023

**A LEVEL
COMPUTER SCIENCE - UNIT 3
1500U30-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2023 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

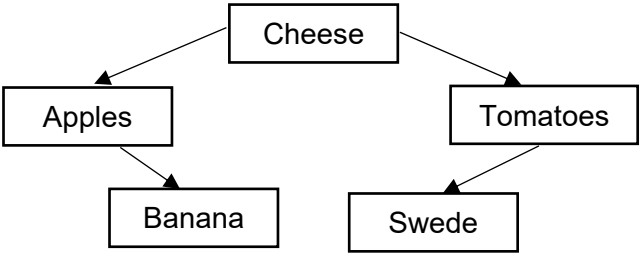# GCE A LEVEL COMPUTER SCIENCE - UNIT 3

SUMMER 2023 MARK SCHEME

Question	Answer	Mark	AO1	AO2	AO3	Total
1. (a)	**One mark for each correct answer up to a maximum of four.**					4
	A hash table stores data using a key/index and a value.	1				
	A hashing algorithm is used to generate a key to identifying at which location the data can be stored.	1				
	The MOD operation is commonly used in a hashing algorithm to generate the key.	1				
	Data can be retrieved using the key to return the value which is direct access.	1	1b			
	If the hashing algorithm generate a key that is already present in the hash table problems can occur such data collision.	1				
	To avoid this one solution would be to used separate chaining where the hash table would use a dynamic data structure like a linked list to so values of the same key.	1				
	Separate chaining would slow the down the overall retrieval for data as both the hash table and linked list would both need to be searched.	1				
	Another solution would linear probing which would store the data in the next available location and assign a new key.	1				
(b) (i)	<table><tr><td>Key</td><td>Value</td></tr><tr><td>1001</td><td>Apple</td></tr><tr><td>1002</td><td>Berry</td></tr><tr><td>1004</td><td>Lime</td></tr><tr><td>1005</td><td>Mango</td></tr><tr><td>1006</td><td>Pear</td></tr><tr><td>1007</td><td>Pineapple</td></tr><tr><td>1008</td><td>Orange</td></tr></table> 1 mark for correct position of Orange. 1 mark for correct removal of Kiwi.	 1 1		2a		2

Question	Answer 2	Mark	AO1	AO2	AO3	Total
(ii)	1 mark for identifying linear probing or suitable description of adding the value in the next available position.

Key	Value
1001	Apple
1002	Berry
1004	Lime
1005	Mango
1006	Pear
1007	Pineapple
1005	Orange
1006	**Peach**

1 mark for correct position of 1006, Peach.

OR

1 mark for identifying separate chaining or suitable description of placing the value in a separate data structure.

Key	Value
1001	Apple
1002	Berry
1004	Lime
1005	Mango
1006	Pear	→ [● Peach]
1007	Pineapple
1005	Orange

1 mark for correct position of 1006, Peach. | 1

1

1

1 | | 2a | | 2 |

Question	Answer	Mark	AO1	AO2	AO3	Total
2.	**One mark for each correct answer up to a maximum of eight.**					8
	Procedural programming supports a logical step-by-step process such as implementing an algorithm.	1				
	Procedural programming follows a top down approach.	1				
	Allows the programmer to define precisely each step when performing a task.	1				
	Provides close control over the underlying operation of the hardware	1				
	Programs are divided into functions.	1				
	Procedural programming relies of the use of iteration, sequence and section.	1	1b			
	Examples of PP include Pascal and C.	1				
	Object orientated programs are divided into objects, classes and methods.	1				
	Can use inheritance to reduce code duplication and flexibility.	1				
	Allows data to be encapsulated making data more secure.	1				
	Easier to expand programs and multiple developers can work on one project without affecting one and others code.	1				
	Examples of OOP are C++ and Java.	1				

Question 3.

A	B	C	$\overline{A}$	$\overline{B}$	$\overline{C}$	$\overline{A}.\overline{B}.C$	$\overline{A}.B.\overline{C}$	$\overline{A}.B.C$	$A.\overline{B}.C$
0	0	0	1	1	1	0	0	0	0
0	0	1	1	1	0	1	0	0	0
0	1	0	1	0	1	0	1	0	0
0	1	1	1	0	0	0	0	1	0
1	0	0	0	1	1	0	0	0	0
1	0	1	0	1	0	0	0	0	1
1	1	0	0	0	1	0	0	0	0
1	1	1	0	0	0	0	0	0	0

$$p = \overline{A}.\overline{B}.C + \overline{A}.B.\overline{C} + \overline{A}.B.C + A.\overline{B}.C$$

Award one mark for each correct expression (as in the columns)

$B.\overline{A} + C.\overline{B}$

Award full marks for correct simplified expression

3.				2b		4
		1				
		1				
		1				
		1				

Question	Answer	Mark	AO1	AO2	AO3	Total
4. (a)	Correct answer can be established using different steps / laws / rules / identities / dual relations. $A.(1 + C) + \overline{B}.(A + B)$ $A.1 + A.C + \overline{B}.(A + B)$ $A.1 + A.C + \overline{B}.A + \overline{B}.B$ $A + A.C + \overline{B}.A + \overline{B}.B$ $A + A.C + \overline{B}.A + 0$ $A + \overline{B}.A$ A Correctly applying identities to arrive at correct answer 5 marks Correctly applying identities but arriving at wrong answer 1 mark	5		2a		5
(b)	Correct answer can be established using different steps / laws / rules / identities / dual relations. $X.(\overline{Y + Z}) + \overline{Z}.X$ $X.(\overline{Y}.\overline{Z}) + \overline{Z}.X$ $X.\overline{Y}.X.\overline{Z} + \overline{Z}.X$ $X.\overline{Y}.\overline{Z} + \overline{Z}.X$ $\overline{Z}.X$ $X.\overline{Z}$ Correctly applying identities to arrive at correct answer 5 marks Correctly applying identities but arriving at wrong answer 1 mark	5		2a		5

4

Question	Answer 5	Mark	AO1	AO2	AO3	Total
5.	**Indicative content**				3a	8

```
1    Declare subprocedure QuickSort(myArray is integer, indexLow
     is integer, indexHi is integer)
2
3    Declare pivot is integer
4    Declare temp is integer
5    Declare low is integer
6    Declare high is integer
7
8    set low = indexLow
9    set high = indexHi
10
11   set pivot = myArray [(int((indexLow + indexHi)/2))]
12
13   while (low <= high)
14
15       while (myArray[low] < pivot and low < indexHi)
16             set low = low + 1
17       end while
18
19       while (pivot < myArray[high] and high > indexLow)
20             set high = high – 1
21       end while
22
23       if (low <= high) then
24             set temp = myArray[low]
25             set myArray[low] = myArray[high]
26             set myArray[high] = temp
27         set low = low + 1
28         set high = high – 1
29       end if
30   end while
31
32   if (indexLow < high) then QuickSort(myArray , indexLow, high)
33   if (low < indexHi) then QuickSort(my Array, low, indexHi)
34
35   End Procedure
```

One mark for each of the following up to a maximum of 8:

Declare / call sub procedure 'QuickSort' with a parameter– Line 1	1
Declaring variables – Lines 3 to 4	1
Initialise pointers (high and low) – Lines 8 to 9	1
Set pivot to data at midpoint – Lines 11	1
Outer loop with terminating condition – Line 13	1
Compare data with pivot – Lines 15 and 19	1
Increment / decrement pointers – Lines 16 and 20	1
Swap elements – Lines 24 to 26	1
Recursion index low, temp high – Line 32	1
Recursion index high, temp low – Line 33	1

5
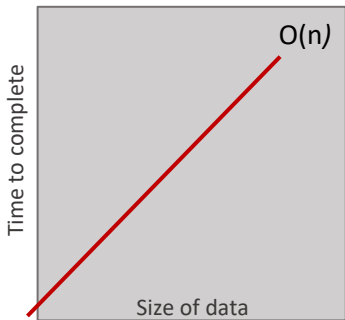
Question	Answer	Mark	AO1	AO2	AO3	Total
6.	**One mark for each correct answer up to a maximum of four**.					4
	Validation is used to ensure any data that is entered by the user is meets specific requirements / is reasonable / accurate.	1				
	Validation and verification are used to minimise the risk of human error when inputting data.	1				
	Validation check can include format checks, range check, types checks and presence checks.	1	1b			
	Verification is used to check that the data entered by the user is consistent.	1				
	The main methods of verification is double entry and comparing the data to the original source such a proof reading.	1				
7. (a) (i)	In-order traversal is applied by visiting the left subtree first (1 mark) then root (1 mark) and finally the right subtree. This method could be when searching for a grocery item (1 mark). Accept any suitable example.	1 1 1		2a		3
(ii)	Post-order traversal is applied by visiting the left subtree first (1 mark) then right subtree (1 mark) and finally the root. This method could be used to delete all the grocery store data (1 mark). Accept any suitable example.	1 1 1		2a		3
(iii)	Pre-order traversal is applied by visiting the root first (1 mark) then left subtree (1 mark) and finally the right subtree. This method could be used to create a copy of the grocery store data (1 mark). Accept any suitable example.	1 1 1		2a		3
(b)	1 mark for suitable example of a balanced tree.	1		2a		1

Question	Answer	Mark	AO1	AO2	AO3	Total
8. (a)	**One mark for each correct answer up to a maximum of three**					3
	Analysis and planning software tools are used in the producing of designs.	1				
	Planning a system structure can be through the uses of flow chart software or UML software.	1				
	These pieces of software allow the developers to produce planning and design documents for individual cases such as the end use or another developer.	1	1b			
	Analysis software tools are also available to be used in requirements engineering and management. This software can be used to record and monitor requirements, use and test cases.	1				
	CASE development tools (specific) / Rational Rose	1				
(b)	**One mark for each correct answer up to a maximum of three**					3
	Integrated development environments (IDEs) are typical pieces of software used in development.	1				
	IDEs can provide a wide range of tools including debugging such as automatic error checking and break points.	1				
	IDEs also allow developers to produce test cases for their software as they develop.	1	1b			
	IDEs can also be used to support multiple developers in the development of a single project.	1				
(c)	**One mark for each correct answer up to a maximum of three**					3
	Program version management software is used as repository for different stages of code development.	1				
	Version can be submitted to a version management software to track and record the changes in projects.	1				
	Version management software is useful when multi developers are working on a single project, it ensures not one develop overwrites someone else code.	1	1b			
	Version management software can also be used to roll-back software if a program becomes corrupt during the development process.	1				
	Accept a suitable example of VCS e.g. Git / Github	1				

Question	Answer 8	Mark	AO1	AO2	AO3	Total
9.	**One mark for each correct answer up to maximum of five.**					5
	<upper> ::= A|B|C . . . Y|Z <lower> ::= a|b|c . . . y|z <digit> ::= 0|1|2 . . . 8|9 <special> ::= !|"|£ . . . @|*	1				
	<letterdigit>::=<upper>|<lower>|<digit> <character>::= <letterdigit>|<special> <name>::=<letterdigit >|< letterdigit ><name> <password> ::= <character>|<character><password > <encryption>::=WEP|WPA <string>::=WIFI: <encryption>:<name>:<password>	1 1 1 1 1		2a		
	Answer not correct if BNF notation used incorrectly. Must include colon (:) for full marks.					
10.	**One mark for definition, one mark for example.**	2				4
	Translation errors **–** usually identified by a compiler where the instructions given cannot be translated to machine code due errors.					
	Syntax error e.g. IF without ENDIF or punctuation error or spelling error if correct words given					
	Linking error e.g. calling a standard function where the correct library has not been linked to the program					
	Semantic Error e.g. Variable declared illegally		1a			
	One mark for definition, one mark for example.	2				
	Execution/Runtime errors – Even though a program will compile and execute it could unexpectedly crash or produce incorrect results.					
	Logical error e.g. division by 0 or use of incorrect logical/comparative operator					
	File handling e.g. When an attempt is made to write to a file that does not exist.					

Question	Answer	Mark	AO1	AO2	AO3	Total
11.	**One mark for each correct answer up to maximum of eight.**					8
	Compilers and interpreters are all examples of translators. Translators are pieces of software used to convert one type of programming language to another.	1				
	Compilers convert high-level programming language source code into object and machine code, run through a single executable file.	1				
	The compilation process can throw multiple errors which at times can make debugging more difficult than using an interpreter.	1				
	Many languages such as C++ and VB.Net are compiled and produce a single executable targeted to one platform or operating system.	1	1b			
	Once an application is compiled it is difficult to review the source code making intellectual property easier to protect.	1				
	Unlike compilers, interpreters convert high-level programming language source code line-by-line.	1				
	An interpreter translates a single line of code into machine code then executes it before moving onto the next.	1				
	An interpreted application does not produce an executable file, meaning source code must be interpreted each time the application is run.	1				
	To execute interpreted source code the code needs to be freely available making intellectual property harder to protect.	1				
	An example of an interpreted language is Python.					

Question	Answer	Mark	AO1	AO2	AO3	Total
12. (a)	1 mark for identifying i loop will execute n times 1 mark for 3 operations outside the loop 1 mark for correct numbers of possible operations 7n + 3 1 mark for determining that the order will be dominated by n 1 mark for determining that the growth rate for time performance is O(n)	1 1 1 1 1			3c	5
(b)	**Linear Complexity O(n)** Time axis labelled correctly Size axis labelled correctly Correct gradient of line Correct identifying linear (complexity).	 1 1 1 1		2a		4

10

Question	Answer	Mark	AO1	AO2	AO3	Total
13.	**Indicative content** • Contemporary devices including smart phones and tablets now do not adopt the traditional interaction technologies such as a keyboard and mouse. • Many devices now employ different methods of human-computer interaction including voice input, touch screen, force feedback, virtual and augmented reality. • Voice input is not common in the everyday smart device including mobile phones and digital assistants. • Many voice-controlled devices use a trigger word to activate them and can carry out a number of computation operations such as playing a song or ordering washing powder. • Sometimes the ambiguity of the spoken language can have an effect on how these operate. • For example, accents and background noise could impact on the quality of the interaction and cause issues. • Phrases that are pronounced the same such as to, two and too also can sometimes cause issues for voice controlled. • This could have impacts on privacy as many companies store all the phrases that are spoken to each device. • Also, people may overhear what commands you are saying whereby your interaction instantly becomes public. • Touch screen are also now commonplace in everyday life, touch screen allows gesture-controlled operations such a pinch-zoom and swiping. • Touch screens are simple and natural to use and can be learnt very quickly. • Although touch screen requires dexterity which may not be suitable for all users. • Touch screen technology can also be fragile and expensive to replace. More often than not, if a touch screen interface breaks the device becomes unusable. • Virtual and augmented reality interfaces are also growing exponentially within the computing industry. • Virtual reality allows full immersive experience for users and allows user to interact with digital interfaces like never before. • Hardware such as omnidirectional treadmills, VR headsets, in-ear aural headphones and touch controllers all heighten the sense of a different reality. • Augmented reality allows the virtual work to mixed with the real world. • Examples of AR are in mobile games and mobile phone app filters.		1b			13
Total						**100**

Band	Q13 AO1b - Max 13 marks
3	**10-13 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 of the indicative content, 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 of the indicative content, 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 of the indicative content, which relate to a limited amount the indicative content. • used limited technical terminology.
0	Response not credit worthy or not attempted.