



GCE A LEVEL MARKING SCHEME

AUTUMN 2021

**A LEVEL
COMPUTER SCIENCE - COMPONENT 1
A500U10-1**

INTRODUCTION

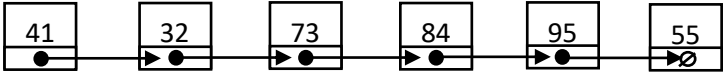
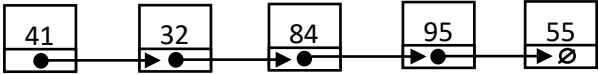
This marking scheme was used by WJEC for the 2021 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' 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.

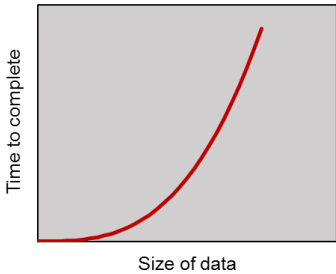
WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

EDUQAS GCE A LEVEL COMPUTER SCIENCE

AUTUMN 2021 MARK SCHEME

Question	Answer	Mark	AO1	AO2	AO3	Total
1. (a)	<p>One mark for each correct point up to a maximum of four</p> <p>This linked list is a dynamic data structure as it can grow and shrink in size after declaration.</p> <p>Each element in this linked list is known as a node, the first element is the head node.</p> <p>Each node consisted of the data itself and the address/reference to the next node.</p> <p>The last node 95 references null.</p> <p>This linked list uses more memory than an array as it needs to store the address/reference of the next node in addition to the data.</p> <p>A node in this linked list cannot be directly accessed and each node needs to be traversed until the correct node is accessed / sequential access.</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>				
(b)	 <p>Award 1 mark for node in correct position</p> <p>Award 1 mark for arrow to and from correct node.</p>	<p>1</p> <p>1</p>				
(c)	 <p>Award 1 mark for node removed</p> <p>Award 1 mark for arrow to and from correct node.</p>	<p>1</p> <p>1</p>				
				2a		4
				2a		2
				2a		2

Question	Answer	Mark	AO1	AO2	AO3	Total
2.	<p>1 mark for each criterion and 1 mark for each description. Max of 8 marks</p> <p>Requirements - evaluate the solution against the original requirements. All requirements should be met for a solution to be successful.</p> <p>Cost – evaluate the solution against costs which include financial costs, human costs and resource costs. A solution must not exceed any negotiated costs to be successful.</p> <p>Robustness - evaluate the solutions against its test results. A solution should use error trapping and validation methods to be successfully robust and reduce the chance of system errors and failures.</p> <p>Usability – evaluate the solution against the ease of use for the end user. A solution should use an intuitive user interface suitable for the end user to be successful.</p> <p>Performance - evaluate the performance of the solution, it should be fully optimised to reduce memory usage. A solution should complete specific task within a given time frame to be successful.</p>	<p>2</p> <p>2</p> <p>2</p> <p>2</p>	<p>1b</p>			8

Question	Answer	Mark	AO1	AO2	AO3	Total
3. (a)	<p>1 mark for identifying the outer loop will execute n times</p> <p>1 mark for identifying inner loop will execute n^2 times</p> <p>1 mark for correct numbers of operations $6n^2 + 2n$</p> <p>1 mark for determining that the order will be dominated by n^2</p> <p>1 mark for determining that the growth rate for time performance is $O(n^2)$</p>	1 1 1 1 1				5
(b)	<p>The algorithm only uses one data structure, a one-dimensional array. Therefore, total storage requirements = 1.</p> <p>As only one data structure is being used, the growth rate for memory will be constant $O(1)$.</p>	1 1				2
(c)	<p style="text-align: center;">Polynomial Complexity $O(n^2)$</p>  <p>Identifying polynomial complexity</p> <p>Time axis labelled correctly</p> <p>Size axis labelled correctly</p> <p>Correct gradient of line</p>	1 1 1 1				4

Question	Answer	Mark	AO1	AO2	AO3	Total
4 (a)	<p>Correct answer can be established using different steps / laws / rules / identities / dual relations.</p> <p>One possible solution: $(A + C).(\bar{A}.B) + (C.B)$ $(A + C).(\bar{A} + C).B$ $C.(A + \bar{A}).B$ $C.(1).B$ $C.B$ $B.C$</p> <p>Correctly applying identities to arrive at correct answer 5 marks</p> <p>Correctly applying identities but arriving at wrong answer 1 mark maximum 4</p>	5 1				5
(b)	<p>Correct answer can be established using different steps / laws / rules / identities / dual relations.</p> <p>One possible solution: $\bar{B}.A.(\bar{B} + A).A + C.1$ $(\bar{B} + \bar{A}).(\bar{B} + A).A + C$ $(\bar{B}.B + \bar{B}.A + \bar{A}.B + \bar{A}.A).A + C$ $(\bar{B} + \bar{B}.A + \bar{A}.B + 0).A + C$ $(\bar{B} + \bar{B}.A + \bar{A}.B).A + C$ $(\bar{B} + \bar{B}.1.B).A + C$ $\bar{B}.A + C$</p> <p>Correctly applying identities to arrive at correct answer 5 marks</p> <p>Correctly applying identities but arriving at wrong answer 1 mark maximum 4</p>	5 1				5

Question	Answer	Mark	AO1	AO2	AO3	Total
5.	<p>1 mark for each method. 1 mark for each reason. Up to a maximum of eight</p> <p>Indicative content</p> <p>External hard drive or memory sticks can be used to store back-up files through copying and pasting.</p> <p>This method is useful of backing up small personal data such as documents and photos. Data can be overwritten with new backups.</p> <p>CD / DVD can be used to store back-up files but are limited to the amount of space that is available. This method of back-up can be used for archiving data due to its read-only nature. Can be used for archiving files and documents.</p> <p>Magnetic tapes can be used to store and routinely back-up network data. This method is used for backing up user network data and shared data including roaming profiles and intranet services.</p> <p>A dedicated back-up server could be used to either mirror a main storage server or routinely back-up network data.</p> <p>Cloud storage solutions can be used to routinely back-up data online and allows for synchronous version management of online files. This method for backup can be used to back up personal files that need to be access from many different devices.</p> <p>Accepted: answers related to speed, capacity, portability, durability, GFS, incremental etc</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>				<p>1b</p> <p>8</p>

Question	Answer	Mark	AO1	AO2	AO3	Total
6.	<p>One mark for each correct point.</p> <p><upper> ::= A B C . . . Y Z <lower> ::= a b c . . . y z <digit> ::= 0 1 2 . . . 8 9 <special> ::= \$ _</p> <p><first> ::= <lower> <special> <letterdigit> ::= <upper> <lower> <digit> _ <character> ::= <letterdigit> <letterdigit><character> <identifier> ::= <first><lower><character></p> <p>Answer not correct if BNF notation used incorrectly.</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>				
				2a		6
7. (a)	<p>Award up to two marks for a description and one for an example</p> <p>Indicative content In-order traversal is applied by visiting the left subtree first, then root and finally the right subtree. This method could be when searching for a file in the file system.</p> <p>Accept any suitable example</p>	3				
				2a		3
(b)	<p>Award up to two marks for a description and one for an example</p> <p>Indicative content Post-order traversal is applied by visiting the left subtree first, then right subtree and finally the root. This method could be used to delete all files in the file system.</p> <p>Accept any suitable example.</p>	3				
				2a		3
(c)	<p>Award up to two marks for a description and one for an example</p> <p>Indicative content Pre-order traversal is applied by visiting the root first, then left subtree and finally the right subtree. This method could be used to create a copy files in the file system.</p> <p>Accept any suitable example.</p>	3				
				2a		3

Question	Answer	Mark	AO1	AO2	AO3	Total
8. (a)	<p>Award one mark for each of the following up to a maximum of two.</p> <p>Analysing an existing system structure can be completed using flow chart software or UML software.</p> <p>These pieces of software allow the developers to produce complete planning and design documents for individual cases such as the end use or another developer.</p> <p>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.</p> <p>Any suitable example of software used in system analysis.</p>	1 1 1 1	1b			2
(b)	<p>Award one mark for each of the following up to a maximum of two.</p> <p>Designing a system structure can be completed using flow chart software or UML software.</p> <p>UX and UI designers use wireframing and mock-up tools for user interfaces and experience.</p> <p>Collaborative code editors could be used to produce pseudocode for review by developers.</p> <p>Any suitable example of software used in system design.</p>	1 1 1 1	1b			2
(c)	<p>Award one mark for each of the following up to a maximum of two.</p> <p>Program version management software is store, record and analyse different stages of code development.</p> <p>Version of software can be submitted through a VCS (version control system) e.g. Git, to an online repository hosting solution to track and record the changes in projects and files e.g. GitHub.</p> <p>Version management software is useful when multiple developers are working on a single project, it ensures one develop does not overwrite another developers code.</p> <p>Version management software can also be used to roll-back software if a program becomes corrupt during the development process.</p>	1 1 1 1	1b			2

Question	Answer	Mark	AO1	AO2	AO3	Total
(d)	<p>Award one mark for each of the following up to a maximum of two.</p> <p>Indicative content</p> <p>Quality assurance / control software to test that a solution conforms to internal and external standards.</p> <p>Test environments can be used to test the portability of software on different platforms such as Linux and Windows.</p> <p>Version control repository can be used to report, monitor and analyse code errors, defects and bugs.</p> <p>Built-in automated testing features within IDEs, such as breakpoints, to generate unit and system performance testing.</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	1b			2
9.	$\begin{array}{r} 11001100_2 \\ \underline{10000000_2} \\ \text{AND } 10000000 \end{array}$ <p>State of sign bit is 1 which is negative</p> <p>Award 1 mark for using an AND or XOR mask.</p> <p>Award 1 mark for correct result</p> <p>Award 1 mark for determining the state of sign bit.</p>	<p>1</p> <p>1</p> <p>1</p>		2a		3

Question	Answer	Mark	AO1	AO2	AO3	Total
10.	<p>Indicative content</p> <pre> 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 </pre> <p>One mark for each of the following up to a maximum of 9:</p> <p>Declare / call sub procedure 'QuickSort' with a parameter 1</p> <p>Declaring variables 1</p> <p>Initialise pointers (high and low) 1</p> <p>Set pivot to data at midpoint 1</p> <p>Outer loop with terminating condition 1</p> <p>Compare data with pivot 1</p> <p>Increment / decrement pointers 1</p> <p>Swap elements 1</p> <p>Recursion index low, temp high 1</p> <p>Recursion index high, temp low 1</p>					
				3a	9	

Question	Answer					Mark	AO1	AO2	AO3	Total
11. (a)	X	Y	X NAND Y	X AND Y	NOT(X NAND Y)					
	0	0	1	0	0					
	0	1	1	0	0					
	1	0	1	0	0					
	1	1	0	1	1					
	Award one mark for each correct column					3				
	Award one mark for correct combinations of X and Y					1				
								2a		4
(b)	A	B	A NOR B	A OR (A NOR B)	NOT B	A OR NOT B				
	0	0	1	1	1	1				
	0	1	0	0	0	0				
	1	0	0	1	1	1				
	1	1	0	1	0	1				
	Award one mark for each correct column					4				
								2a		4

Question	Answer	Mark	AO1	AO2	AO3	Total
12.	<p>Indicative content</p> <p>A programming paradigm is the structure and approach of a programming language.</p> <p>There are many different types of programming paradigms all of which are aimed at solving different programming problems.</p> <p>Procedural programming languages are executed sequentially and are composed a series of programming commands and constructs executed one after the other.</p> <p>Procedural programming is an imperative language as the programmer controls the flow and state of the computer programming.</p> <p>These programming languages include sequence commands such as PRINT and INPUT and sections and iteration constructs such as IF and WHILE.</p> <p>Procedural languages are usually employed when implementing algorithms as they are programmed linearly, they are not suitable for GUI based problems given the event driven nature of these applications.</p> <p>Procedural programming is very easy to learn and implement although it is not very suitable for complex problems. Examples of procedural programming languages are C and Pascal.</p> <p>Event-Driven programming is a form of object-oriented programming which contains objects such as buttons, combo boxes and list boxes to create a GUI.</p> <p>Event-driven programming uses event listeners to listen for events such as Click or Hover Over to which code can be attached and executes when a specific event occurs.</p> <p>OOP event-driven programming is very effective when an application needs a rapid development of a GUI.</p> <p>Some languages are known as multi-paradigm languages and are highly versatile and can be used in many different ways e.g. Python.</p> <p>Different programming languages use a variety of different translators to convert programming code into machine code.</p> <p>Compilers translate high-level language into machine code.</p>		1b			12

Question	Answer	Mark	AO1	AO2	AO3	Total
	<p>The compiler produces a standalone executable file or package.</p> <p>A compiled program can be executed without the need for the compiler to be installed on the destination machine.</p> <p>The compiled application can be distributed to any machine with the OS it was targeted at, it can be run multiple times.</p> <p>Compiled programs give some form of protection of intellectual property as the source code is not distributed to the destination machine.</p> <p>Compilers target a specific platform e.g. iOS or Windows. Once compiled for this platform the executable can only be run on that platform.</p> <p>Compiled programs cannot be compiled if they have any errors throughout any of the source code. This can be difficult to debug without the use of an IDE.</p> <p>IT software needs to be distributed to more than one OS or architecture it will need to be recompiled and possibly reprogrammed.</p> <p>Examples of compiled languages include Java and C++.</p> <p>Interpreters, unlike, compilers translate one line of high-level source code into machine code line-by-line.</p> <p>Each line of machine code is executed before the next is translated. Each time the program is run the code needs to be interpreted again.</p> <p>For an interpreted application to be run you must have the source code, this means intellectual property is difficult to manage.</p> <p>If an error is found in an interpreted application, it will crash at that specific line meaning it can be easier to debug.</p> <p>Code can be distributed to machines of different OS and platforms as long as they have installed an appropriate interpreter.</p> <p>Examples of interpreted languages include JavaScript and Python.</p> <p>One line of compiled or interpreted high-level source code can be many lines of machine code.</p>					

Band	Q12 AO1b - Max 12 marks
3	<p style="text-align: center;">10-12 marks</p> <p>The candidate has:</p> <ul style="list-style-type: none"> • 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	<p style="text-align: center;">5-9 marks</p> <p>The candidate has:</p> <ul style="list-style-type: none"> • 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	<p style="text-align: center;">1-4 marks</p> <p>The candidate has:</p> <ul style="list-style-type: none"> • 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 not credit worthy or not attempted.