GCE A LEVEL MARKING SCHEME

SUMMER 2023

A LEVEL
COMPUTER SCIENCE - COMPONENT 1
A500U10-1

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.

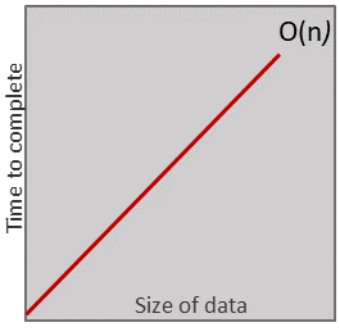
WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

GCE A LEVEL COMPUTER SCIENCE

SUMMER 2023 MARK SCHEME

Question	Answer	Mark	AO1	AO2	AO3	Total
1. (a)	An algorithm is a sequential solution (1 mark) to solve a specific problem (1 mark).	2	1.1			2
(b)	Flow charts can be used to define algorithms. Flow charts are a diagrammatic visualisation of the inputs, outputs and processes completed by an algorithm. Pseudocode can be used define algorithms. Pseudocode is a generic programming language than cannot be translated int to machine code but can be are interpretable by a developer. Structured English can be used to define algorithms. Structured English breaks down compiled algorithm into simple English words to help show a step-by-step solution.	1 1 1 1 1 1	1.1 1.1 1.1			2
2. (a)	Correct answer can be established using different steps / laws / rules / identities / dual relations. One possible solution: $(X + Z).(\overline{Z + X})$ $(X + Z).(\overline{Z}.\overline{X})$ $(X + Z).(\overline{X}.\overline{Z})$ $X.\overline{X}.X.\overline{Z} + Z.\overline{X}.Z.\overline{Z}$ $X.\overline{X}.\overline{Z} + \overline{X}.Z.\overline{Z}$ $0.\overline{Z} + \overline{X}.0$ $0 + 0 = 0$ Correctly applying De Morgan's Law 1 mark Correctly applying identities to arrive at correct answer 5 marks Correctly applying identities but arriving at wrong answer 1 mark	 1 5		 2.1 2.1		6
(b)	Correct answer can be established using different steps / laws / rules / identities / dual relations. One possible solution: $B.(A + C).A.(A + C)$ $(B.A) + (B.C).A$ $A.B + A.B.C$ $A.B + B.C$ $A.B$ Correctly applying identities to arrive at correct answer 4 marks Correctly applying identities but arriving at wrong answer 1 mark	 4		 2.1		4

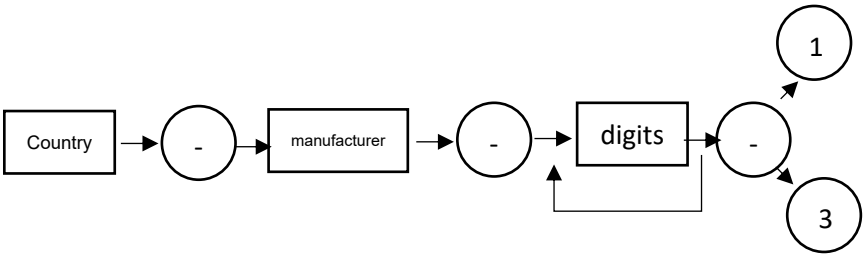
Question	Answer	Mark	AO1	AO2	AO3	Total
3. (a)	Award one mark for each correct description and one mark for each appropriate example up to a maximum of four.					4
	• User documentation should be straight forward and targeted specially for the end user.	1	1.1			
	• It must contain instructions on how to undertake any task using the system.	1				
	• It must not contain overly technical information or descriptions and should be user friendly.	1				
	• It should be an accompanying manual for after the end user has undertaken appropriate training on how to use the system.	1				
		1				
	• Tutorials and step-by-step instructions on how to perform tasks	1				
	• Referencing manual and glossary	1				
	• Trouble shooting guide, common errors and problems	1				
	• Frequently asked questions	1				
(b)	Award one mark for each correct description and one mark for each appropriate example up to a maximum of four.		1.1			4
	• Maintenance documentation should be technical documentation aimed at the person who manages and configure the software or system.	1				
	• This could include IT technicians who understands all aspects of the system including the software and hardware used.	1				
		1				
	• pseudocode and annotated listings	1				
	• Diagrams such as UML	1				
	• Data structure documents	1				
	• Algorithm designs including flowcharts	1				
	• Variable lists	1				
	• Data dictionaries	1				
	• Design documents	1				
	• Installation and configuration instructions and support	1				
	• Hardware and software requirements	1				

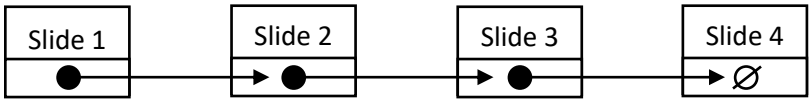
<table>
<tr><th>Question</th><th>Answer</th><th>Mark</th><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th></tr>
<tr><td>4. (a)</td><td>
<table>
<tr><td>A</td><td>B</td><td>$A + B$</td><td>$A.B$</td><td>$\overline{\overline{A}.\overline{B}}$</td><td>$\overline{\overline{A}} + \overline{\overline{B}}$</td></tr>
<tr><td>0</td><td>0</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>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
Award one mark for each correct column (in bold) up to a maximum of 3
Award one mark for correct combinations of A and B</td><td>3
1</td><td></td><td>2.1
2.1</td><td></td><td>4</td></tr>
<tr><td>(b)</td><td>
<table>
<tr><td>A</td><td>0</td><td>1</td><td>$\mathbf{A + 0}$</td><td>$\mathbf{A.1}$</td><td>$\mathbf{A + A}$</td><td>$\mathbf{A.A}$</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
</table>
Award one mark for each correct column (in bold)</td><td>4</td><td></td><td>2.1</td><td></td><td>4</td></tr>
<tr><td>5. (a)</td><td>1 mark for correct numbers of outer operations 10
1 mark for identifying i loop will execute n times
1 mark for correct numbers of operations 4n + 10
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)</td><td>1
1
1
1
1</td><td></td><td></td><td>3.1
3.1
3.1
3.1
3.1</td><td>5</td></tr>
<tr><td>(b)</td><td>The algorithm only uses one data structure, a one-dimensional array. Therefore, total storage requirements = 1 array.
As only one data structure is being used, the memory used will be constant O(1).</td><td>1
1</td><td></td><td></td><td>3.1
3.1</td><td>2</td></tr>
<tr><td>(c)</td><td>Linear Complexity O(n)
 

Identifying linear complexity
Time axis labelled correctly
Size axis labelled correctly
Correct gradient of line</td><td>

1
1
1
1</td><td></td><td>

2.1
2.1
2.1
2.1</td><td></td><td>4</td></tr>
</table>

Question	Answer	Mark	AO1	AO2	AO3	Total
6. (a)	<country> ::= 000|001|002 . . . 998|999 <digit> ::= 0|1|2 . . . 8|9 <digits> ::= <digit> |<digit><digits> <manufacturer> ::= <digit>|<digit><digit>|<digit><digit><digit>|<digit><digit><digit><digit> |<digit><digit><digit><digit><digit> <product> ::= <digits> <check> ::= 1|3 <barcode>::= <country > - <manufacturer > - <product> - <check> Answer not correct if BNF notation used incorrectly. Must include hyphen (-) for full marks.	1 1 1 1 1		2.1		5
(b)	Barcode Syntax Diagram  Marking One mark for country and manufacturer code boxes One mark for terminal symbols (1/3) or checkdigit box One mark for terminal symbol (-) or hypen boxes One mark for repeating digits (must have arrow) or product box	 1 1 1 1				4

Question	Answer	Mark	AO1	AO2	AO3	Total
7. (a)						2
	1 mark for suitable ordered examples and pointers	1		2.1		
	1 mark for containing both the data and memory location of next item	1		2.1		
(b)	Any of the following up to a maximum of 3.					3
	A linked list is dynamic and can grow and shrink.	1		2.1		
	A linked list can only store similar data types.	1		2.1		
	Rearranging / adding / inserting can take a lot of time in an array.	1		2.1		
	Memory utilisation is more efficient in a linked list as it only uses the memory it has data stored in unlike an array.	1		2.1		
(c)	A stack would be the most suitable data structure to store each user edit.	1		2.1		4
	A stack follows the last in first out (LIFO/FILO) principle.	1		2.1		
	Data is added (pushed) on the top of the structure.	1		2.1		
	Data is accessed and removed (popped) also from the top of the structure which is suitable for storing and accessing a user edits starting with the most recent.	1		2.1		

Question	Answer	Mark	AO1	AO2	AO3	Total
8.	Max mark of 8. **Indicative content** • Computers are not prevalent in the almost all industries. • Computers have created a massive industry of their own increasing the demand for computing professionals. • Many manufacturing businesses now employ computing equipment not only to manage information but in production through they use of automated systems such as robotics. • Computer have replaced many factory and repetitive jobs in recent years. • This has allowed a massive increase in people pursuing more creative or innovation career paths. • Computers can be less expensive that traditional workers whereby the production and manufacturing costs are decreased increasing profit. • Computers tend to be more accurate and reliable and reduces the chance of human error. • Many jobs have disappeared all together due to computers causing unemployment. • Learning computers for some generations can be difficult and re-training can be impossible. • Many new computer systems or digital solutions can be extremely expensive to design and implement. • Many jobs have been created in the wider industry due to computers many within the internet sector. • These can include jobs in e-commerce and digital marketing.	 1 1 1 1 1 1 1 1 1 1 1 1	1.1			8

Question	Answer	Mark	AO1	AO2	AO3	Total
9.	Data compression is reducing the amount of memory a file uses.	1	1.1			6
	The level of file compression is measured using a compression ratio. A compression ratio is the size of the compressed file divided by the original file size.	1				
	Compression algorithms are used to employ different methods to reduce file size depending on the type of file.	1				
	There a two main types of file compression algorithms lossy and lossless.	1				
	Lossy compression algorithms reduce a file size but some data is lost during this process and cannot be retrieved.	1				
	Lossless compression algorithms reduce a files size without the loss of any data and the original file can be retrieved.	1				
	JPEG is a lossy compression method for images. (Accept any suitable example)	1				
	PNG is a lossless compression method for images. (Accept any suitable example)	1				

10.	**Indicative content**
	
	`1 Declare Procedure InsertionSort`
	`2`
	`3 Declare myArray[0 … 999] is string`
	`4 Declare i, j, currentItem is integer`
	`5`
	`6 for i = 0 to len(myArray) – 1`
	`7`
	`8 currentItem = myArray[i]`
	`9`
	`10 set j = i`
	`11`
	`12 while (j > 0 and myArray[j – 1] > currentItem)`
	`13`
	`14 myArray[j] = myArray[j – 1]`
	`15`
	`16 set j = j - 1`
	`17`
	`18 endwhile`
	`19`
	`20 myArray[j] = currentItem`
	`21`
	`22 next i`
	`23`
	`24 End Procedure`
						9

	Declare and initialise variables	1			3.3	
	Use of outer loop with terminating condition	1			3.3	
	Use of inner loop with terminating condition	1			3.3	
	Correct condition in outer loop	1			3.3	
	Correct insertion of data	1			3.3	
	Correct condition in inner loop	1			3.3	
	Decrement j	1			3.3	
	Assign correct currentItem	1			3.3	
	Increment i	1			3.3	

Question	Answer	Mark	AO1	AO2	AO3	Total
11.	One mark for each point up to a maximum of 6. *Lexical analysis* Comments and unneeded spaces are removed Keywords, constants and identifiers are replaced by 'tokens' A symbol table is created which holds the addresses of variables, labels and subroutines *Syntax analysis* Tokens are checked to see if they match the spelling and grammar expected, using standard language definitions. This is done by parsing each token to determine if it uses the correct syntax for the programming language. If syntax errors are found, error messages are produced *Semantic analysis* Variables are checked to ensure that they have been properly declared and used Variables are checked to ensure they are of the correct data type, e.g. float values are not being assigned to integers	 1 1 1 1 1 1 1 1	1b			6

Question	Answer	Mark	AO1	AO2	AO3	Total
12.	**Indicative content** Discuss the possible effects of computers on the nature of employment in the computing industry and wider society. • Computers now are commonplace in most if not every workplace. Employers now require basic computer skills in almost every job. • With the growth of computing many people have had to acquire new skills to meet the use of technology in the workplace and employment. • Computers are much more cost effective in the workplace. • Skills can be learnt instantly by a computer unlike with a human where skills would need to be trained and developed over a period of time. • Computers are more accurate than humans and could operate with greater precision. • Computers also do not require holidays, breaks and time off and can technically work 24/7. • Robotics has become one of the most widely used aspects of computers in the workplaces. • Robotics are now used in nearly every stage of manufacture such as the car making industry. • The impact this has had is that now manufacturing companies will employ less people to perform jobs than can be easily replicated by robots and computers. • This has led to a redundant workforce in many areas of the workplace. • In addition to manufacturing, less skilled general work such as typists and security have now been replaced with digital technology. • Email has impacted greatly on postal services with the numbers of physical letters being sent reduced significantly leading to further job loss. • However, as the use of computers for repetitive jobs has grown in industry this has meant that people now seek more creative and alternative career paths. • Computers have created a vast industry where there are many job opportunities • Network managers, web developers, software engineers, social media managers for example. (Any example) • Employees can now work from home more easily allowing for more flexible working patterns.		1.1			12

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 not credit worthy or not attempted.