



---

# **GCE A LEVEL MARKING SCHEME**

---

**SUMMER 2023**

**A LEVEL  
COMPUTER SCIENCE - COMPONENT 2  
A500U20-1**

## **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 – COMPONENT 2**

### **SUMMER 2023 MARK SCHEME**

#### **Guidance for examiners**

##### **Positive marking**

It should be remembered that learners are writing under examination conditions and credit should be given for what the learner writes, rather than adopting the approach of penalising him/her for any omissions. It should be possible for a very good response to achieve full marks and a very poor one to achieve zero marks. Marks should not be deducted for a less than perfect answer if it satisfies the criteria of the mark scheme.

For questions that are objective or points-based the mark scheme should be applied precisely. Marks should be awarded as indicated and no further subdivision made.

For band marked questions mark schemes are in two parts.

Part 1 is advice on the indicative content that suggests the range of computer science concepts, theory, issues and arguments which may be included in the learner's answers. These can be used to assess the quality of the learner's response.

Part 2 is an assessment grid advising bands and associated marks that should be given to responses which demonstrate the qualities needed in AO1, AO2 and AO3. Where a response is not credit worthy or not attempted it is indicated on the grid as mark band zero.

##### **Banded mark schemes**

Banded mark schemes are divided so that each band has a relevant descriptor. The descriptor for the band provides a description of the performance level for that band. Each band contains marks.

Examiners should first read and annotate a learner's answer to pick out the evidence that is being assessed in that question. Once the annotation is complete, the mark scheme can be applied.

This is done as a two-stage process.

##### **Stage 1 – Deciding on the band**

When deciding on a band, the answer should be viewed holistically. Beginning at the lowest band, examiners should look at the learner's answer and check whether it matches the descriptor for that band. Examiners should look at the descriptor for that band and see if it matches the qualities shown in the learner's answer. If the descriptor at the lowest band is satisfied, examiners should move up to the next band and repeat this process for each band until the descriptor matches the answer.

If an answer covers different aspects of different bands within the mark scheme, a 'best fit' approach should be adopted to decide on the band and then the learner's response should be used to decide on the mark within the band. For instance if a response is mainly in band 2 but with a limited amount of band 3 content, the answer would be placed in band 2, but the mark awarded would be close to the top of band 2 as a result of the band 3 content. Examiners should not seek to mark candidates down as a result of small omissions in minor areas of an answer.

## **Stage 2 – Deciding on the mark**

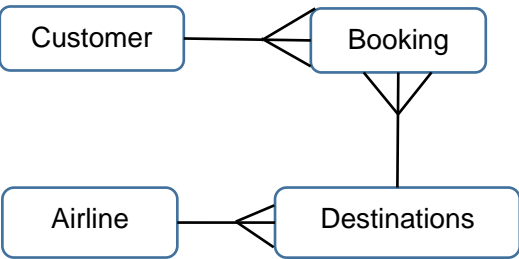
Once the band has been decided, examiners can then assign a mark. During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by the Principal Examiner. Examiners should mark the examples and compare their marks with those of the Principal Examiner.

When marking, examiners can use these examples to decide whether a learner's response is of a superior, inferior or comparable standard to the example. Examiners are reminded of the need to revisit the answer as they apply the mark scheme in order to confirm that the band and the mark allocated is appropriate to the response provided.

Indicative content is also provided for banded mark schemes. Indicative content is not exhaustive, and any other valid points must be credited. In order to reach the highest bands of the mark scheme a learner need not cover all of the points mentioned in the indicative content but must meet the requirements of the highest mark band. Where a response is not creditworthy, that is contains nothing of any significance to the mark scheme, or where no response has been provided, no marks should be awarded.

Question	Answer	Mark	AO1	AO2	AO3	Total
1. (a)	<p><b>One</b> mark for each advantage, to a maximum of <b>three</b> marks.</p> <ul style="list-style-type: none"> <li>• Higher capacity / Require less space / the same data can be stored over a smaller surface area.</li> <li>• Readable from any direction.</li> <li>• Damage resistant when printed / built in error correction</li> <li>• Allow for structured appending / data split over multiple codes</li> <li>• Scanning software or application is supplied with smartphones</li> </ul>	3	1b			7
(b)	<p><b>One</b> mark for a use, to a maximum of <b>two</b> marks and <b>one</b> mark for each associated description.</p> <p><b>Indicative content</b></p> <ul style="list-style-type: none"> <li>• Calendar data. Including appointment details that may be saved directly to a digital diary.</li> <li>• Location data. That can be scanned and processed to give directions.</li> <li>• Email address. That can be used to open a blank email / locator form with pre-defined recipient and subject.</li> </ul> <p>Allow similar responses for SMS, Phone number etc.</p>	4	1b			

Question	Answer	Mark	AO1	AO2	AO3	Total
2. (a)	<p><b>One</b> mark for each correct explanatory point, to a maximum of <b>four</b>.</p> <ul style="list-style-type: none"> <li>• The use of data, statistical algorithms / machine learning / modelling techniques.</li> <li>• to identify the likelihood of future outcomes / trends.</li> <li>• Based on historical data.</li> <li>• Provides an assessment of what will happen in the future.</li> <li>• Produce data visualisations</li> <li>• Data cleansing and transformation</li> </ul>	4	1b			6
(b)	<p><b>One</b> mark for each relevant source identified, to a maximum of <b>two</b> marks.</p> <ul style="list-style-type: none"> <li>• Publicly shared comments about travel / holidays on social media.</li> <li>• Sensors in smart devices, such as location sensors.</li> <li>• Online questionnaires / hotel satisfaction surveys.</li> </ul> <p>Allow similar responses relevant to leisure and tourism data.</p>	2		2b		

Question	Answer	Mark	AO1	AO2	AO3	Total
3. (a)	<p><b>One</b> mark for each statement and <b>one</b> mark for an associated expansion, to a maximum of <b>six</b> marks.</p> <p>Data redundancy</p> <ul style="list-style-type: none"> <li>Occurs when duplicate data is available in different tables.</li> <li>Resulting of wastage of storage and compromising data consistency.</li> </ul> <p>Data consistency</p> <ul style="list-style-type: none"> <li>Changes made to different occurrences of data is controlled and managed in such a way that all the occurrences of a specific data item have the same value.</li> <li>Ensuring searches produce consistent results.</li> </ul> <p>Data independence</p> <ul style="list-style-type: none"> <li>This refers to the separation of information from the applications and programs that use it.</li> <li>So that modifications to source code are not required every time changes to the data characteristics / properties are made.</li> </ul>	6	1b			
(b) (i)	<p><b>One</b> mark for each correct one-to-many relationship, to a maximum of <b>three</b> marks.</p>  <p>Accepted but not expected: 5 table solution.</p>	3		2b		13
(ii)	<p><b>One</b> mark for <b>Primary key</b> in both <b>Customer</b> and <b>Booking</b> tables</p> <p><b>One</b> mark for each foreign key field, appropriately identified to a maximum of <b>three</b> marks.</p> <p><b>Indicative content:</b></p> <p>Customer (CustomerID [<b>P</b>], Name, HouseNo, Postcode)</p> <p>Booking (BookingID [<b>P</b>], DestinationID [<b>F</b>], CustomerID [<b>F</b>] Date, Duration)</p> <p>Destination (DestinationID [<b>P</b>], AirlineID [<b>F</b>], Name, Country)</p> <p>Airline (AirlineID [<b>P</b>], AirlineName, Destination)</p> <p>Accepted but not expected: 5 table solution.</p>	4		2b		

Question	Answer	Mark	AO1	AO2	AO3	Total
4.	<p><b>Indicative content</b></p> <pre> Loop   INP Temp   {Input current temperature}         STA Temp   {Store current temperature}         LDA Temp   {Load current temperature to                     the accumulator}          SUB num1   {Subtract target temperature}         BRP Label1 {Branch if result is positive}         BRA Loop   {Return to beginning of Loop} Label1  LDA 1         OUT        {Output 1 to turn on air                     conditioning}          HLT num1    DAT 21 </pre> <p><b>One</b> mark for each step correctly coded to a maximum of <b>six</b> marks</p> <ul style="list-style-type: none"> <li>• input of current temperature</li> <li>• loading the current temperature into the accumulator</li> <li>• Label1 and BRP command</li> <li>• subtracting the target temperature</li> <li>• output 1 to turn on air conditioning</li> <li>• correct repetition of Loop</li> </ul>	6			3b	6



Question	Answer	Mark	AO1	AO2	AO3	Total
5. (a)	<p><b>One</b> mark for each relevant statement to a maximum of <b>four</b> marks</p> <ul style="list-style-type: none"> <li>• Function of the CPU scheduler.</li> <li>• Reference to priorities</li> <li>• Reason for delay in process execution.</li> <li>• Maximise use of CPU.</li> </ul> <p><b>Indicative content</b></p> <p>CPU scheduling is a process that allows one process to use the CPU while the execution of another process is on hold (waiting state) due to unavailability of any resource like I/O etc, thereby making full use of CPU.) Whenever the CPU becomes idle, the operating system must select one of the processes / jobs in the ready queue to be executed., The selection process is carried out by the CPU scheduler. The scheduler selects from among the processes in memory that are ready to execute, according to set priorities, and allocates the CPU to one of them.</p>	4	1a			8
(b)	<p><b>One</b> mark for disadvantage and <b>one</b> mark for suitable expansion to a maximum of <b>two</b> marks.</p> <p><b>One</b> mark for possible solution and <b>one</b> mark for suitable expansion to a maximum of <b>two</b> marks.</p> <p>If new higher priority processes keep coming into the ready queue, then the processes waiting in the ready queue with lower priority may have to wait for long durations before execution. Possibly leading to indefinite blocking or starvation. The concept of aging can be used to prevent starvation of any process. Where the priority of a low-priority job is incremented as waiting time increases.</p>	2 2	1b 1b			

Question	Answer	Mark	AO1	AO2	AO3	Total																																	
6. (a)	<p><b>One</b> mark for reference to mathematical function and <b>one</b> mark for length conversion.</p> <p><b>Indicative content</b></p> <p>A hashing algorithm is a process that includes a mathematical hashing function. It that converts input data of arbitrary length into a compressed numerical hash value of fixed length.</p>	2	1b			8																																	
(b)	<p><b>One</b> mark for each correct total, to a maximum of <b>two</b> marks.</p> <p><b>One</b> mark for each correct K position, to a maximum of <b>two</b> marks.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>B</td><td>7</td><td>A</td><td>D</td><td></td><td>3</td><td>Z</td><td>Z</td><td>3</td><td>W</td><td></td> </tr> <tr> <td>6</td><td>3</td><td>6</td><td>6</td><td><b>23</b></td><td>3</td><td>9</td><td>9</td><td>3</td><td>8</td><td><b>33</b></td> </tr> <tr> <td>6</td><td>9</td><td>5</td><td>8</td><td><b>8</b></td><td>5</td><td>0</td><td>0</td><td>5</td><td>7</td><td><b>7</b></td> </tr> </table> <p><math>238 \text{ MOD } 99 = 40</math>    <math>337 \text{ MOD } 99 = 40</math></p>	B	7	A	D			3	Z	Z	3	W		6	3	6	6	<b>23</b>	3	9	9	3	8	<b>33</b>	6	9	5	8	<b>8</b>	5	0	0	5	7	<b>7</b>	2  2		2b  2b	
B	7	A	D		3		Z	Z	3	W																													
6	3	6	6	<b>23</b>	3	9	9	3	8	<b>33</b>																													
6	9	5	8	<b>8</b>	5	0	0	5	7	<b>7</b>																													
(c)	<p><b>One</b> mark for each method to a maximum of <b>two</b> marks.</p> <p>Placing the data in the next available free position in the hash table. / Description of linear probing by specified interval.</p> <p>Chaining / Storing the data as a linked list node and placing a pointer to the node in the hash table position.</p> <p>Use of an overflow area. / Placing a pointer in the hash table to the overflow area / carrying out a linear search of the overflow</p>	2	1b																																				

Question	Answer	Mark	AO1	AO2	AO3	Total
7. (a)	<p><b>One</b> mark for each of the following to a maximum of <b>four</b> marks</p> <ul style="list-style-type: none"> <li>• Correct construct (CREATE TABLE with brackets in correct places)</li> <li>• Identifying PRIMARY KEY</li> <li>• NOT NULL on key field</li> <li>• Numeric(x,2), 2 has to be present x can be any sensible number representing pounds.</li> </ul> <p><b>Indicative content</b></p> <pre>CREATE TABLE DESTINATION ( destinationCode char NOT NULL, destinationName char NOT NULL, hotelName char, emailAddress char, costPerNight numeric (5,2), PRIMARY KEY (destinationCode), ); or CREATE TABLE DESTINATION ( destinationCode char NOT NULL PRIMARY KEY, destinationName char NOT NULL, hotelName char, emailAddress char, costPerNight numeric (5,2); );</pre>	4			3b	10
(b) (i)	<p><b>One</b> mark for correct insert code.</p> <pre>INSERT INTO BOOKING VALUES ('BK00012', 'Ms P Evans', 6, 'HK05', '09/09/2023', 6575.00);</pre>	1			3b	
(ii)	<p><b>One</b> mark for correct update code</p> <pre>UPDATE DESTINATION SET costPerNight = 275.50 WHERE destinationCode ='TH12';</pre>	1			3b	
(iii)	<p><b>One</b> mark for SELECT <b>one</b> mark for ORDER BY</p> <pre>SELECT destinationCode, emailAddress, FROM DESTINATION ORDER BY destinationName;</pre>	2			3b	
(iv)	<p><b>One</b> mark for Between and AND, <b>One</b> mark for correct dates and for &gt;=4</p> <pre>SELECT bookingNo, customerName, FROM BOOKING WHERE (((departureDate) Between "01/07/2023" And "31/07/2023") AND ((passengers)&gt;=4));</pre>	2			3b	

Question	Answer	Mark	AO1	AO2	AO3	Total																											
8. (a)	<p><b>One mark for each correct stage to a maximum of four marks.</b></p> $  \begin{array}{r}  9_{16} \quad 00001001 \\  B_{16} \quad 00001011 \\  + \quad 00010100 \\  \hline  000010110  \end{array}  $ <p>Total Carry (allow ones only)</p>	4		2b		13																											
(b)	<p><b>One mark for correct conversion, one mark for shift 1 and one mark for shift 2.</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td><math>-44_{10}</math></td> </tr> <tr> <td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>Shift1</td> </tr> <tr> <td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>Shift2</td> </tr> </table>	1	1	0	1		0	1	0	0	$-44_{10}$	1	1	1	0	1	0	1	0	Shift1	1	1	1	1	0	1	0	1	Shift2	3		2b	
1	1	0	1	0	1		0	0	$-44_{10}$																								
1	1	1	0	1	0		1	0	Shift1																								
1	1	1	1	0	1	0	1	Shift2																									
(c)	<p><b>One mark for each correct stage.</b></p> <p>Conversion = <math>1000001.11_2</math>  Exponent = <math>0111_2</math>  Answer = <math>0.10000011100 \ 0111_2</math></p>	3		2b																													
(d)	<p><b>One mark for each correct stage.</b></p> <p>Calculate exponent: +5  Move binary point: <math>011010.01</math>  Decimal Equivalent: 26.25</p>	3		2b																													

Question	Answer	Mark	AO1	AO2	AO3	Total
9. (a)	<p><b>One</b> mark for each correct point, to a maximum of <b>three</b>.</p> <ul style="list-style-type: none"> <li>• It encrypts data</li> <li>• using a Caesar Cypher</li> <li>• applied to the ASCII code of the input text</li> </ul>	3		2b		6
(b)	<p><b>One</b> mark for each correct point, to a maximum of <b>three</b>.</p> <ul style="list-style-type: none"> <li>• The value on line 28 of the algorithm defines the value of the shift variable in the cypher.</li> <li>• For output 1 the shift was 4 this has been increased to 8 for output 2.</li> <li>• Shifting 'T' in Testing by 4 produces 'X' shifting the 'T' by 8 produces a loop / rotation back to the beginning of the alphabet to produce 'B'</li> </ul>	3		2b		

Question	Answer	Mark	AO1	AO2	AO3	Total
10. (a)	<p><b>One</b> mark for description of IP and <b>one</b> mark for description of TCP.</p> <p>The Internet Protocol (IP) is the address system of the Internet / has the core function of delivering packets of information from a source device to a target device.</p> <p>TCP is used in conjunction with IP in order to maintain a connection between the sender and the target / to ensure packet order and for error checking.</p>	2	1b			6
(b)	<p><b>One</b> mark for each stage of handshaking to a maximum of three and <b>one</b> mark for description of breaking down / reassembly of packets.</p> <p>Source sends SYN 'initial request' packet to the target server in order to start the dialogue.</p> <p>Target server responds with a SYN-ACK packet to agree to the process.</p> <p>Source sends an ACK packet to the target to confirm the process.</p> <p>The email message is broken down into packets, sent via the Internet / traverses a series of gateways before arriving at the target device where the group of packets are reassembled by TCP</p>	4	1b			

Question	Answer	Mark	AO1	AO2	AO3	Total												
11. (a)	<p><b>One</b> mark for each correct cost and <b>one</b> mark for each correct route</p> <table border="1"> <thead> <tr> <th>Source</th> <th>Destination</th> <th>Cost</th> <th>Route</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>F</td> <td>8</td> <td>A,B,F</td> </tr> <tr> <td>E</td> <td>G</td> <td>19</td> <td>E,F,B,G</td> </tr> </tbody> </table>	Source	Destination	Cost	Route	A	F	8	A,B,F	E	G	19	E,F,B,G	4		2b		8
Source	Destination	Cost	Route															
A	F	8	A,B,F															
E	G	19	E,F,B,G															
(b)	<p><b>One</b> mark for each correct step to a maximum of <b>four</b> marks.</p> <ul style="list-style-type: none"> <li>• Convert to bytes</li> <li>• Convert to bits</li> <li>• Convert to Kbits</li> <li>• Divide by transfer speed and round.</li> </ul> <p><b>Indicative content:</b></p> <p>220 KB x 1024 = 225280 B  225280 B x 8 = 1802240 b  1802240 / 1000 = 1801.14 Kb  1801.14 / 200 Kbps = 9.0057 = <b>9 s</b></p>	4		2b														

Question	Answer	Mark	AO1	AO2	AO3	Total
12.	<p>From <b>one</b> mark up to a total of <b>nine</b> marks awarded by application of mark bands</p> <p><b>Indicative content:</b></p> <ul style="list-style-type: none"> <li>• Partitioning allows for separate processes to be allocated to the partitioned areas of main memory.</li> <li>• Without partitioning every process would have to be loaded into memory separately once the proceeding process had been executed significantly slowing down the overall process.</li> <li>• An operating system's memory management function keeps track of the status of each memory location, either allocated or free to ensure its effective and efficient use.</li> </ul> <p>Two memory management techniques:</p> <ul style="list-style-type: none"> <li>• Contiguous, where each executing process must be loaded entirely into one partition of main memory.</li> <li>• Non-contiguous, where processes can be divided into different parts and fill the space in main memory. This has the advantage of reducing memory wastage, but slows execution because time is consumed in address translation.</li> </ul> <p>The consequences of partitioning will vary according to the partition method used, either fixed, variable or dynamic.</p> <p>Fixed partitioning.</p> <ul style="list-style-type: none"> <li>• The simplest method used to put more than one process into main memory.</li> <li>• The partitions are made before execution or during system configuration.</li> </ul> <p>Possible consequences include:</p> <ul style="list-style-type: none"> <li>• Internal Fragmentation: Main memory use is inefficient. Any program, no matter how small, occupies an entire partition. This can cause internal fragmentation.</li> <li>• External Fragmentation: The total unused space of various partitions cannot be used to load processes</li> <li>• Limited process size: Processes of size greater than the size of the largest partition in main memory cannot be accommodated.</li> <li>• Limitation on degree of multiprogramming: Partitions in main memory are made before execution. The number of processes cannot be greater than the number of partitions in memory.</li> </ul>	9	1b			9



Question	Answer	Mark	AO1	AO2	AO3	Total
	<p>Variable partitioning is a system for dividing memory into non-overlapping but variable sizes. The number of partitions is fixed but the size of each partition may vary. More flexible as small processes are allocated to small partitions and large processes allocated to larger partitions.</p> <p>Dynamic Partitioning.</p> <ul style="list-style-type: none"> <li>• Partitions are not made before execution but during run-time according to processes' needs, with the size of partition equal to the size of incoming process.</li> <li>• The number of partitions is not fixed but depends on the number of incoming processes and size of main memory.</li> </ul> <p>Consequences arising from dynamic partitioning.</p> <ul style="list-style-type: none"> <li>• No Internal fragmentation.</li> <li>• No restriction on degree of multiprogramming</li> <li>• No restriction of process size.</li> </ul> <p>Disadvantages</p> <ul style="list-style-type: none"> <li>• More difficult to implement as it requires allocation of memory during run-time.</li> <li>• External fragmentation may still arise as e.g., partitions initially allocated to a 2 MB and a 1MB process cannot be re-allocated to a 3 MB process after execution as each process must be accommodated within one partition.</li> </ul>					

Band	Q12 Max 9 marks
3	<p style="text-align: center;"><b>7–9 marks</b></p> <p><b>The candidate has:</b></p> <ul style="list-style-type: none"> <li>• written an extended response that has a sustained line of reasoning which is coherent, relevant, and logically structured</li> <li>• shown clear understanding of the requirements of the question and a clear knowledge of the topics as specified in the indicative content.</li> <li>• addressed the question appropriately with minimal repetition and no irrelevant material</li> <li>• has presented a balanced response and justified their answer with examples</li> <li>• effectively drawn together different areas of knowledge, skills and understanding from all relevant areas across the course of study</li> <li>• used appropriate technical terminology confidently and accurately.</li> </ul>
2	<p style="text-align: center;"><b>4–6 marks</b></p> <p><b>The candidate has:</b></p> <ul style="list-style-type: none"> <li>• written a response that has an adequate line of reasoning with elements of coherence, relevance, and logical structure</li> <li>• shown adequate understanding of the requirements of the question and a satisfactory knowledge of the topics as specified in the indicative content.</li> <li>• presented a response with limited examples</li> <li>• drawn together different areas of knowledge, skills and understanding from a number of areas across the course of study</li> <li>• used appropriate technical terminology.</li> </ul>
1	<p style="text-align: center;"><b>1–3 marks</b></p> <p><b>The candidate has:</b></p> <ul style="list-style-type: none"> <li>• written a response that that lacks sufficient reasoning and structure</li> <li>• produced a response which is not well developed</li> <li>• attempted to address the question but has demonstrated superficial knowledge of the topics specified in the indicative content.</li> <li>• used limited technical terminology.</li> </ul>
0	Response is not credit worthy or not attempted.