



GCE A LEVEL MARKING SCHEME

SUMMER 2022

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

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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 1

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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

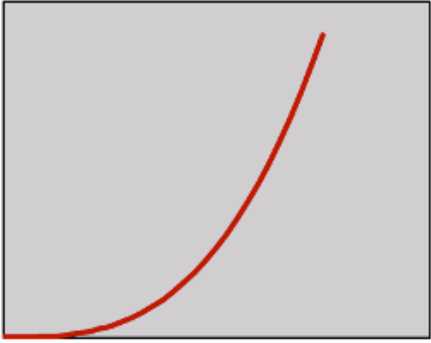
Once the band has been decided, examiners can then assign a mark. During standardising (marking conference), detailed advice from the Principal Examiner on the qualities of each mark band will be given. Examiners will then receive examples of answers in each mark band that have been awarded a mark by 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>Definition of hash table i.e. a structure that can map keys to values.</p> <p>A hash table uses a hash function to compute an <i>index</i>, also called a <i>hash code</i>, into an array of <i>buckets</i> or <i>slots</i>, from which the desired value can be found.</p> <p>Collisions how they are handled</p> <p>They are widely used in many kinds of computer software, particularly for associative arrays, database indexing, caches, and sets.</p> | <p>1</p> <p>1</p> <p>1</p> <p>1</p> | | | | |
| | | | 1b | | | 4 |
| (b) (i) | <p>If data was attempted to be inserted into <code>snowfall_dataset[10]</code> an error would occur.</p> <p>The error is caused as position 10 is out of the bounds of the array.</p> | <p>1</p> <p>1</p> | | | | |
| | | | | 2a | | 2 |
| (ii) | <p>The one-dimensional array is suitable for this data as the dataset comprises of single values of the same data type.</p> <p>A one-dimensional array is suitable for this dataset as using a data structure allows for efficient processing of the data e.g. sorting and searching.</p> | <p>1</p> <p>1</p> | | | | |
| | | | | 2a | | 2 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------|-----|-----|-----|-------|
| 2. (a) | <p>Correct answer can be established using different steps / laws / rules / identities / dual relations.</p> <p>Indicative content</p> $\overline{B}.(C + A.B) + \overline{B}.(A + C)$ $(\overline{B}.C + \overline{B}.A.B) + \overline{B}.(A + C)$ $(\overline{B}.C + \overline{B}.A.B) + \overline{B}.(A + C)$ $(\overline{B}.C + A.0) + \overline{B}.(A + C)$ $(\overline{B}.C + 0) + \overline{B}.(A + C)$ $(\overline{B}.C) + (\overline{B}.A + \overline{B}.C)$ $(\overline{B}.C) + (\overline{B}.A)$ <p>Correctly applying identities to arrive at correct answer 5 marks.</p> <p>Correctly applying identities but arriving at wrong answer 1 mark for each correct step up to a maximum of 4.</p> | | | 2a | | 5 |
| (b) | <p>Correct answer can be established using different steps / laws / rules / identities / dual relations.</p> <p>Indicative content</p> $\overline{\overline{A.B.B} + \overline{\overline{C}}}$ $\overline{\overline{A.B.B} + \overline{C}}$ $\overline{\overline{A.B} + \overline{B} + \overline{C}}$ $\overline{A.B + \overline{B} + \overline{C}}$ $\overline{A + \overline{B} + \overline{C}}$ <p>Correctly applying De Morgan's Law 1 mark.</p> <p>Correctly applying identities to arrive at correct answer 5 marks</p> <p>Correctly applying identities but arriving at wrong answer 1 mark for each correct step up to a maximum of 4</p> | | | 2b | | 5 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------|-----|-----|-----|-------|
| 3. (a) | <p>1 mark for each of the following up to a maximum of 5:</p> <p>1 mark for identifying input n will execute 1 time</p> <p>1 mark for identifying i loop will execute n times</p> <p>1 mark for identifying j and k loops will execute n^2 times</p> <p>1 mark for correct numbers of operations $n + 2n^2$</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> | | | | 3c | 5 |
| (b) | <p style="text-align: center;">$O(n^2)$ polynomial complexity</p>  <p style="text-align: center;">Size of data</p> <p>One mark for each of the following:</p> <p>Graph entitled correctly with $O(n)$ or Polynomial Complexity.</p> <p>Time axis labelled correctly</p> <p>Size axis labelled correctly</p> <p>Correct gradient of line.</p> | | | 2b | | 4 |
| (c) | <p>The algorithm only uses three integers which are declared outside of the loops. Therefore, the total memory usage remains the same through the single run.</p> <p>(As the memory usage does not change during the run, the growth rate is constant $O(1)$).</p> | 1 | | | | |
| | | 1 | | | 3c | 2 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|---|-----|-----|-----|-------|
| 4. (a) | <p>One mark for each of the following:</p> <p>The lifetime of the variable m is during the call of the function straightLine.</p> <p>As soon as the straightLine function call ends the variable lifetime ends.</p> | | | 2b | | 2 |
| (b) | <p>One mark for each of the following:</p> <p>The variable y has local scope in the function straightLine.</p> <p>The variable cannot be accessed outside of the straightLine function for example by the inputVal function.</p> | | | 2b | | 2 |
| 5. | <p>One mark for each of the following up to a max of 8:</p> <p>There is different legislation designed to protect computer security including the Computer Misuse Act (1990).</p> <p>The Computer Misuse Act (1990) protects both individuals, businesses and national security.</p> <p>The Computer Misuse Act (1990) legislation protects against unauthorised access to computer material.</p> <p>Unauthorised access to computer systems with an intent to commit further offences.</p> <p>Unauthorised acts with intent to impair or damage the operation of computer systems.</p> <p>The maximum sentence for committing a Computer Misuse Act (1990) offence against business and individuals is 14 years imprisonment.</p> <p>If a Computer Misuse Act (1990) offence is a threat to national security a sentence of lifetime imprisonment can be imposed.</p> <p>The Investigatory Powers Act (2016) allows the government to intercept, monitor and record digital communications to protect national security or against serious crime.</p> <p>These communications can be through mobile telecommunications, user browser history / ISPs data and health records etc.</p> <p>The Investigatory Powers Act (2016) allows government security services (GCHQ, MI5 and MI6) to preform equipment interference (hacking) to protect national security.</p> <p>The Data Protection Act 2018 mandates for secure storage of personal and private data</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>1</p> <p>1</p> | | | | 8 |
| | | | 1b | | | |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|-------------|-----|-----|-----|-------|
| 6. (a) | <p>One mark for each of the following up to a max of 2:</p> <p>The DIV operator is used to perform integer division.</p> <p>Integer division is used to find the integer quotient (left part of a decimal number) after division.</p> <p>Accept any correct example of DIV e.g. $9 \text{ DIV } 2 = 4$ or $9 // 2 = 4$</p> | 1 1 1 | | | | 2 |
| (b) | <p>One mark for each of the following up to a max of 2:</p> <p>The MOD (modulo) operator is used to find the modulus when one number is divided by another.</p> <p>The modulus is the integer remainder (right part of a decimal number) after division.</p> <p>Accept any correct example of MOD e.g. $9 \text{ MOD } 2 = 1$ or $9 \% 2 = 1$</p> | 1 1 1 | | | | 2 |
| (c) (i) | <p>One mark for each of the following up to a max of 2:</p> <p>The algorithm identifies odd numbers in an array of integers.</p> <p>The algorithm counts the amount of odd numbers and outputs the total.</p> <p>The algorithm uses sequence, selection and iteration.</p> | 1 1 1 | | | | 2 |
| (ii) | <p>One mark for each of the following up to a max of 2:</p> <p>Sequencing is where one line of code is executed one after the other.</p> <p>Sequencing is used in both procedural programming and object-orientated programming.</p> <p>Accept any correct example of sequencing e.g. proceeding from line 4 onto line 5.</p> | 1 1 1 | | | | 2 |
| (iii) | <p>One mark for each of the following up to a max of 2:</p> <p>Selection uses a Boolean expression (condition) to determine which line of code to execute next.</p> <p>Selection is used in both procedural programming and object-orientated programming.</p> <p>Accept any correct example of selection e.g. line 9</p> | 1 1 1 | | | | 2 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|------|-----|-----|-----|-------|
| 7. | <p>One mark for first two correct lines then one mark for each correct up to a maximum of five plus one mark for correct answer</p> <p>Indicative content</p> <pre> <upper> ::= A B C . . . Y Z <digit> ::= 0 1 2 . . . 8 9 <hexa-digit> ::= <digit> A B ... E F <digits> ::= <digit> <digit><digits> <hexa> ::= <hexa-digit> <hexa-digit><hexa> <surname> ::= <upper> <upper><surname> <post-code> ::= <digits> <ID> ::= <digit><digit><digit><digit><digit><digit> <validation-code> ::= <surname>»<post-code>»<ID>»<hexa> </pre> <p>Answer not correct if BNF notation used incorrectly. Must include chevron (») for full marks.</p> | | | | | |
| | | | | 2a | | 6 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|--|-----|-----|-----|-------|
| 8. | <p>One mark for each of the following up to a max of 8:</p> <p>Program version management is an approach used to track and save source code throughout the software development process.</p> <p>Program version management tools are commonly integrated into IDEs e.g. Visual Studio.</p> <p>Examples of program version management tools include Git and Mercurial. (1 mark for any correct example)</p> <p>These version management tools create different versions (or commits) of source code to track changes and development.</p> <p>These versions can be stored on a local machine which known as local version control.</p> <p>Or the versions can be stored on a local server which known as centralised version control.</p> <p>Each version can include comments on what has been developed in that particular version and how.</p> <p>Version management tools can also be used to roll-back to a previous version if a program becomes corrupt or an bug is found during the development process.</p> <p>Version management tools also allows code to be reviewed and checked before they committed to a master version.</p> <p>Cloud-based repositories can also be used to provide distributed (cloud-based) version control e.g. GitHub or BitBucket.</p> <p>Using cloud-based distributed version control will ensure developers always have access to the most up-to-date versions of the source code.</p> <p>Distributed version control is useful when a software development team are working on different aspects of a single project.</p> <p>Using version control is an essential maintaining quality control and assurance in software development</p> <p>Version control is also essential for tracking bugs and issues in source code.</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>1</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> | | | | |
| | | | 1b | | | 8 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|---|-----|-----|-----|--------------------|
| 9. | <p>One mark for each of the following up to a max of 6:</p> <p>Decomposition is the process of breaking a complex problem (requirements / application) down into smaller subproblems.</p> <p>These subproblems are easier to manage throughout the entire software development process.</p> <p>If a complex problem is not decomposed the project will be too difficult to solve and become unmanageable.</p> <p>If a problem is too complex it is prone to errors, bugs and going over its initial costs.</p> <p>An example of a subproblem for the given requirements would be 'To design and develop the back-end database'. – Accept any suitable example</p> <p>Abstraction is the process of ignoring or removing specific information and data to allow developers to focus on the the important details of a specific subproblem.</p> <p>Abstraction allows developers to think about a problem in more general terms.</p> <p>This allows developers to identify common solutions to the general problem they have abstracted</p> <p>If a problem is not abstracted the solution can become unnecessarily complicated.</p> <p>An example of abstraction for the given requirements would be identifying 'to allow customers to find products.' as a common searching problem. – Accept any suitable example</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>1</p> <p>1</p> | | | | <p>2b</p> <p>6</p> |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|------|-----|-----|-----|-------|
| 10. | <p>Indicative content</p> <pre> 1 Start Procedure BubbleSort 2 declare myArray[] of integer 3 declare i is integer 4 declare temp is integer 5 6 set i = 0 7 set swap = TRUE 8 while (swap == TRUE) 9 set swap = FALSE 10 set i = 0 11 for i to len(myArray[]) - 1 12 if myArray[i] < myArray[i + 1] 13 set temp = myArray[i] 14 set myArray[i] = myArray[i + 1] 15 set myArray[i + 1] = temp 16 set swap = TRUE 17 end if 18 next i 19 endwhile 20 End Procedure </pre> <p>One mark for each of the following:</p> <ul style="list-style-type: none"> Declare and initialise variables Use of loops with correct condition Initialise i to 0 Correct condition in IF statement (<) Set temp to myArray[j] Set myArray[j] to myArray[j + 1] Set myArray[i] to temp Set swap to True Increment i | | | | 3c | 9 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|--|---|-----------|-----|-----|-------|
| 11. | <p>One mark for each of the following:</p> <p>Natural language can be defined as the spoken and written words humans use to communicate with one and other.</p> <p>In natural language words can be ambiguous, one word can have more than one meaning.</p> <p>An example of an ambiguous word in English is 'break'. – Accept any suitable example.</p> <p>Computer language syntax can be defined as the set of rules that program statements must follow.</p> <p>High-level computer language syntax must be unambiguous.</p> <p>Each program statement must have a specific purpose.</p> <p>If there was ambiguity in computer language syntax it would be impossible to translate into machine code.</p> <p>An example would be the statement 'break'. The break statement must force the program leave a construct and nothing else. – Accept any suitable example.</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> | | | 8 |

| Question | Answer | Mark | AO1 | AO2 | AO3 | Total |
|----------|---|------|-----|-----|-----|-------|
| 12. | <p>Indicative content</p> <p>The amount of internet-enabled devices has increased exponentially over the last 10 years.</p> <p>These devices have allowed people to be more connected than ever. People are now connect to each other 24 hours 7 days a week.</p> <p>With this increase more social software applications have been developed including image sharing sites, micro-blogging, dating services and social networks.</p> <p>With the growth of online social interaction has come a growth of online anonymity which has resulted in negative communications such as cyber bullying and trolling.</p> <p>Many social applications profit from user data and advertising. Many services own the content that is uploaded or shared by its users.</p> <p>This makes a users digital footprint (online activity) hard to maintain, track and control.</p> <p>There have been many reports of users who have shared negative content years ago which resurfaces and causes problems in their modern day life.</p> <p>It is important to that users remain professional and polite at all times when communicating through social software applications as they may not know the long lasting impacts of the content they share.</p> <p>Many employers are reported to research potential employees on social and profession networks to get an overview of their online identity.</p> <p>Many businesses now have professional codes of conduct.</p> <p>These codes of conduct outline the acceptable workplace and ethical standards to which employees must abide when communicating and sharing content online.</p> <p>Each employee agrees to act according to the clear guidelines outlines in a code of conduct usually by signing a formal contract or even by accepting the job.</p> <p>If an employee breaks a code of conduct, then action can be taken against them for breaching this contract.</p> <p>Disciplinary proceedings and policies are usually clearly laid out within a code of conduct which outline what action is taken in a breach.</p> <p>Sharing or creating negative/extreme content online can result in an employee dissimal.</p> <p>A person can also face up to two years imprisonment by committing offences outlined in the Malicious Communications Act (1988) if the content they share or create is:</p> <ul style="list-style-type: none"> • Grossly offensive • A threat • False and known or believed to be false by the sender. | | 1b | | | 12 |

| Band | Q12 AO1b - Max 12 marks |
|------|---|
| 3 | <p style="text-align: center;">9-12 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 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 | <p style="text-align: center;">5-8 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 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 | <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 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. |