



GCE A LEVEL EXAMINERS' REPORTS

**COMPUTER SCIENCE
A LEVEL**

SUMMER 2023

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COMPUTER SCIENCE

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COMPONENT 1

General Comments

All Candidates performance across questions						
Question Title	N	Mean	S D	Max Mark	F F	Attempt %
1	614	1.9	1.2	4	46.6	99.2
2	615	6.6	3.5	10	66.5	99.3
3	610	2.8	2.7	8	34.9	98.5
4	608	6.5	2.1	8	80.7	98.2
5	605	5.1	2.9	11	46.5	97.7
6	607	4.7	2.5	9	52.8	98.1
7	610	4.4	2.5	9	48.4	98.5
8	609	3.6	1.9	8	44.9	98.4
9	608	3.7	1.6	6	61.5	98.2
10	581	3.8	2.9	9	41.7	93.9
11	581	2.9	2.2	6	49.0	93.9
12	615	5.3	2.4	12	44.0	99.3

All questions were well attempted by candidates, with most candidates being well prepared and demonstrating the expected standard of knowledge and application required at an A2 level. There was a range of answers, with many candidates achieving higher marks, particularly in questions involving Boolean algebra, Big O, and BNF.

Comments on individual questions/sections

Q.1 A mean mark of 1.9 out of 4 with a facility factor of 46.6

The question, focused on the definition and technical methods of defining algorithms, was fairly well responded to by candidates. Overall, most candidates were awarded marks for the question, it being easily accessible as an opening item.

Q.2 A mean mark of 6.6 out of 10 with a facility factor of 66.5

Mostly, the Boolean algebra questions were well answered, with many candidates simplifying their expressions to their simplest forms using various methods. As in the previous series, some candidates correctly applied many Boolean algebraic identities, though they arrived at incorrect answers due to misapplication at earlier stages.

Q.3 A mean mark of 2.8 out of 8 with a facility factor of 34.9

Some candidates demonstrated a sound understanding of the contents of user and maintenance documentation.

However, few candidates were able to access the full 8 marks, with many only able to identify one to two documentation components. Centres should ensure they make full use of past papers and marking schemes in preparing candidates for future examinations.

Q.4 – A mean mark of 6.5 out of 8 with a facility factor of 80.7

This question proved less demanding for many candidates, with a significantly acceptable accessibility rating and overall mean. In parts (a) and (b), many candidates were able to fully determine and prove Boolean identities through the use of truth tables. Most candidates demonstrated their technical skills throughout the paper, with other items on Boolean algebra also being well answered.

Q.5 A mean mark of 5.1 out of 11 with a facility factor of 46.5

The question required candidates to evaluate an algorithm using Big O notation. In part (a), some candidates identified the algorithm as linear ($O(n)$) and evaluated the algorithm well. Very few candidates did not calculate the correct number of operations as they did not include variable declarations in their total. In part (b), most candidates were able to correctly determine the growth rate. Part (c) was well answered, with most candidates drawing the correct growth rate and labelling it.

Q.6 – A mean mark of 4.7 out of 9 with a facility factor of 52.8

The question was well answered by most candidates, with many scoring 4 - 5 marks. Candidates demonstrated their technical skills through BNF and showed familiarity with the style of the question, which has appeared repeatedly in previous papers. Many candidates were only awarded marks in part (a), as only some were familiar with the correct syntax diagram notation required for part (b). Centres are encouraged to familiarise students with the correct syntax diagram notation moving forward.

Q.7 – A mean mark of 4.4 out of 9 with a facility factor of 48.4

Most candidates demonstrated a sound understanding of linked lists and stack data structures. In part (a), candidates responded with a suitable diagram, but some did not provide suitable pointers. Some candidates provided data structures unsuitable for awarding marks in part (c), e.g., a binary tree or queue. The majority of candidates gave technical descriptions of stack operations such as pop and push etc. in part (b).

Q.8 A mean mark of 3.6 out of 8 with a facility factor of 44.9

This question, which was very open, was accessible to candidates. There was a wide range of responses, and examiners are commended for their use of their expert, professional knowledge when marking this item. Given the ever-changing nature of the topic, the social, economic, and legal impact of computers, there were many responses that focused on artificial intelligence (AI), which were awarded marks. The content in the mark scheme is indicative, not definitive, of what can be awarded. Many students also repeated some of the points made in their responses to question 12, and these responses were awarded marks as long as they were contextualised to the impact on employment.

Q.9 A mean mark of 3.7 out of 6 with a facility factor of 61.5

The majority of candidates very well attempted and answered the question. Many candidates fully demonstrated their knowledge of lossy and lossless compression, indicating how well this topic is taught in centres.

Q.10 – A mean mark of 3.8 out of 9 with a facility factor of 41.7

This question was less well answered than in previous years, potentially because the algorithm is not as simple as a Bubble Sort. Many candidates were able to produce a correct solution for an Insertion Sort, and there was a wide range of correct responses. Many candidates were awarded marks for using suitable programming constructs such as variable declaration and terminating loops. Centres are encouraged to utilise the algorithms provided in previous series' marking schemes as learning materials to prepare candidates.

Q.11 – A mean mark of 2.9 out of 6 with a facility factor of 49.0

Most candidates were able to demonstrate their knowledge of the stages of compilation, including lexical, syntax, and semantic analysis. Many candidates went in-depth about these stages, however, some also discussed types of compilers in-depth. Centres are reminded to encourage candidates to consider the number of marks being awarded for a question and respond with a structured answer accordingly.

Q.12 – A mean mark of 5.3 out of 12 with a facility factor of 44.0

This question required candidates to describe and give examples of the effects of computers on the nature of employment and wider society. Most candidates achieved average marks on this question. Some candidates were awarded full marks for clearly demonstrating their knowledge in the context of the given question, whereas many candidates sometimes do not do this, limiting the marks they can be awarded. Centres are encouraged to ensure candidates use technical terminology and real-world examples in the context of the question to achieve higher marks.

Summary of key points

As in previous years, candidates should be encouraged to include more technical terminology when answering knowledge-focused questions, such as those concerning the nature of computers and their impact on employment. Centres should also encourage a deeper understanding of topics such as technical and maintenance documentation. Candidates should ensure that their handwriting is fully legible; if this cannot be achieved, they should explore suitable alternative methods, such as word processing the examination, where appropriate.

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COMPONENT 2

General Comments

The majority of candidates were well prepared and were able to demonstrate a wide knowledge of the topics in the specification, as required at A2 level. Questions requiring precise responses to programming or mathematical problems generally produced high marks, whereas questions requiring more descriptive answers often produced responses that were correct but lacked adequate reasoning or detail to gain high marks.

Comments on individual questions/sections

- Q. 1 QR codes for data input. Mean mark of 3.3 out of 7 with a facility factor of 47.4. This question was intended to provide an accessible start to the paper and most candidates identified suitable uses of QR codes, based on their own experience. The advantages of QR codes tended to concentrate on convenience of using a smart phone and often did not consider the possible scope of data, or resilience of the codes.
- Q. 2 Predictive analytics. Mean mark of 2.4 out of 6 with a facility factor of 40.2. Most candidates were able to explain the purpose and process of making predictions based on historic data, within the context of the question. The identification of sources of unstructured data, as required for part (b) proved to be more challenging.
- Q. 3 Database systems. Mean mark of 6.4 out of 13 with a facility factor of 49.3. The explanations of data redundancy and consistency were generally accurate, but most candidates were unfamiliar with the concept of data independence. Candidates were more familiar with the design work required and the ERDs and data tables tended to be well done, but with some errors arising in the identification of foreign keys.
- Q. 4 Assembly language. Mean mark of 4.3 out of 6 with a facility factor of 72.1. This is a well taught and practised topic, and most candidates were able to translate the logic of the given algorithm into assembly code, using the instruction set provided.
- Q. 5 CPU scheduling. Mean mark of 2.2 out of 8 with a facility factor of 27.1. Candidates generally found it challenging to produce a response that referred to process priorities and described maximising use of the CPU. Responses to part (b) which refers to a disadvantage of priority based scheduling tended to be more focused with several candidates referring to the concepts of starvation and aging of low priority jobs.
- Q. 6 Hashing algorithm. Mean mark of 4.1 out of 7 with a facility factor of 51.0. Many candidates spent time writing lengthy and sometimes inaccurate explanations on the purpose and operation of a hashing algorithm. It is important that candidates match the detail of their responses to the marks available. For part (b) many candidates presented accurate calculations of the storage positions and were therefore able to correctly address part (c) by identifying two methods for dealing with clashes.

- Q. 7 SQL commands. Mean mark of 5.4 out of 7 with a facility factor of 54.4. This is another well taught and practised topic, and most candidates were able to produce the required commands correctly, although some failed to distinguish between text and numeric fields ('...') as required.
- Q. 8 Number representations. Mean mark of 9.5 out of 13 with a facility factor of 72.8. The question that proved to be the most accessible on the paper, with several examples of full marks recorded. The majority of candidates were able to carry out the required conversions and demonstrate binary addition and arithmetic shifts as required. Where marks were lost this tended to be due to errors in the replacement bits when shifting the negative two's complement number, for part (b).
- Q. 9 Algorithm process and outputs. Mean mark of 2.2 out of 6 with a facility factor of 36.7. Responses for part (a) usually correctly identified that the algorithm carried out encryption using ASCII codes, and some referred to a Caesar cypher. For part (b) the change in the shift value was noted by most candidates but few went on to describe the alphabet loop involved.
- Q. 10 TCT/IP protocols. Mean mark of 1.6 out of 6 with a facility factor of 26.8. The question with the lowest facility factor. The importance of the protocols was not well described and whilst candidates were generally clear on the purpose of handshaking, few were able to correctly describe the process in any detail.
- Q. 11 Network routing costs. Mean mark of 3.0 out of 8 with a facility factor of 37.9. The calculations of routing costs were generally well done, but very few candidates included the required conversion from bytes to bits in their calculation of the transfer time.
- Q. 12 Partitioning of main memory. Mean mark of 2.7 out of 9 with a facility factor of 29.6. The low facility factor suggests that there may have been some timing issues at this stage of the paper. Several candidates correctly based their responses on fixed, variable and dynamic partitioning and were able to describe the implications of each technique. Less successful responses tended to concentrate on the management of secondary storage as opposed to main memory, as required.

Summary of key points

As in previous series programming, calculation and database questions were generally well answered. For descriptive questions candidates should concentrate on the technical aspects of the topic and include examples to illustrate and help structure their responses.

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COMPONENT 3

General Comments

A wide range of projects were submitted for moderation this summer, moderators saw many projects of a good standard as well as some of an excellent standard. Many centres had assessed the work accurately and used clear comments to explain their assessment decisions which aided the moderation process.

This specification requires work to be uploaded. In addition, candidates' functional solutions should also be included in the coursework submission. Centres should ensure that candidates' solutions are presented in a format that allows moderators to run the candidates' programs with ease.

It would aid the moderation process if centres would ensure that candidates' work and documentation are saved with filenames that clearly identify the centre number, candidate number and candidate name. As detailed in the specification for this qualification, "For example Diane Smith (centre number 69999, candidate number 12345) would store her work in a folder named 69999_12345_SM_D.

It is an essential requirement that all candidate work is authenticated, and the authentication sheets are uploaded with the candidates' work. In the recent series much time was spent by moderators and WJEC officers contacting centres to request the missing paperwork.

The Joint Council for Qualifications (JCQ) document "Instructions for conducting nonexamination assessments" states that:

"All candidates must sign a declaration to confirm that the work they submit for final assessment is their own unaided work. Teachers must sign a declaration of authentication after the work has been completed confirming that:

- the work is solely that of the candidate concerned;
- the work was completed under the required conditions;
- signed candidate declarations are kept on file."

It should also be noted that any additional candidates' work and/or paperwork requested by moderators should be provided in a timely manner.

Comments on individual questions/sections

Discussion

This section provides opportunities for the candidates to present their problem situations to their teacher, peers and/or other competent third parties. Moderators should have a clear idea of the scope of the proposed idea and the potential for complexity. It is important candidates present ideas that are of an A-Level standard that can access the full range of marks available.

Candidates should receive detailed informed feedback regarding the scope of their chosen problem and should reflect, in depth, on the discussions and feedback to allow them to firm up their ideas and ensure that unsuitable topics are revised or discarded. This is a good opportunity for teachers to steer candidates away from unsuitable ideas that will lack the scope required to produce work to a standard and level appropriate for this qualification. Some candidates are simply describing their feedback rather than using it to reflect and refine their ideas. This section gives the candidates the opportunity to reflect on the feedback including a justification of their decision to accept or reject certain ideas that have been presented. There is also the opportunity at this stage for candidates to reframe their problem or identify a new more appropriate problem.

Investigation

The investigation section gives candidates the opportunity to explore the problem they have identified and further refine their ideas, linking to each section of the investigation.

Candidates are encouraged to select suitable real-life problems as they then have the opportunity to carry out an investigation into a current system. Candidates should identify the data collected, processed and output by the current system, allowing them to maintain this complexity while building in new options to solve different problems.

Desk based research allows candidates to investigate similar commercial solutions created to solve a similar problem. This is intended to provide candidates with informed ideas for further development of their systems. This research is an important part of the project as it should inform the design process. In addition, it is essential to note that the final section of the NEA requires candidates to evaluate their final solutions against the commercial systems.

Where candidates are not able to identify a real-life problem, or have a new idea that does not have any current end users, they should carry out extended research into similar commercial systems, identifying common characteristics and should base the conclusions of their investigations on the information that they have been able to gather.

Stakeholders are a key section that is often not given appropriate consideration. It is important for candidates to consider the different needs of stakeholders, the best candidates will have considered the needs of all the stakeholders and clearly shown this in their objectives.

At the end of this section it is important candidates produce a comprehensive working specification with measurable objectives that will inform the design, prototyping and testing process. The objectives should be determined by each section of their investigation, often students will propose ideas in their research but not follow this through in the objectives.

Design

The aim of the design section is to create a design that could be created by a competent third party. The quality of candidates designs are improving with many centres seeing the importance of good design structure before candidates start building systems.

Candidates should be encouraged to relate all elements of their design to their project. In some centres candidates are describing concepts such as validation checks and sorting constructs, it would be more beneficial for students to explain how these will be used in their project.

Prototype

It is useful to see more centres using video evidence to provide evidence of the prototype, this enables the moderators to see the system running and the sample evidence used by the candidates.

Candidates should identify the areas to be prototyped. These areas should cover the essential sections of the solution and be justified by the candidate as to why these have and have not been included. Centres should note that the extent of the prototype will reflect the nature of the chosen problem.

This element of the prototype is intended to allow self-reflection on the chosen method of solution and the design work. Strengths and weaknesses of the current solution should be identified with some proposals for improvement, it is not appropriate to include feedback from third parties in this section of the work.

Post-prototype refinement of design

This section of the project is intended to allow candidates to consider third party feedback and to decide what changes, if any, should be made to the original design. It is useful if the feedback comes from competent third parties who have the technical knowledge to give constructive advice required to refine the design of the work to date.

As with the discussion it is important for the candidates to reflect on the feedback given and consider which design elements they will accept and which will be rejected.

Some centres have shown some excellent practice in this section, clearly showing the before and after of the change to any design. This greatly aids moderation as the changes can be easily identified alongside the feedback given by a third party.

Some centres are still including the programmed solution as evidence in this section rather than the expected changes to design.

Software development

It was pleasing to see a wide variety of project ideas with many being highly successful and reaching the top mark bands. Many centres are using a range of different methods of development including additional libraries and PHP. Moderators are required to run the program, a READ ME file aids this process and gives the candidate the opportunity to identify any libraries they have used as well as any usernames and passwords required to enter the system. Candidates are required to identify any libraries on their candidate declaration form.

Testing

Again it is very useful to see centres making use of video evidence to demonstrate their testing, this enables the moderator to see the system being used as well as suitable test data. It is important for candidates to demonstrate a range of test data including typical, extreme and invalid data where appropriate.

It is important that the testing work should focus on the functionality of the solution in terms of:

- Input facilities including measures to ensure reasonable data entry
- Processing facilities to ensure correct and accurate output
- Appropriate output including screen and paper-based outputs

The testing should cover each objective with data designed to measure the outcomes of the system against the desired outcome. The quality of the commentaries accompanying the testing evidence has a major role in identifying the marks to be awarded for this section of the work. Candidates should give specific suggestions to refine the system with any tests that do not successfully pass testing.

Evaluation

The evaluation section is improving with many candidates giving detailed evaluative comments about their system and the process they have completed. Candidates do need to cover all elements of the evaluation to achieve the higher mark bands, this should include:

- Produced a detailed evaluation of the effectiveness of the programming language and justified the tools and techniques used
- Compared and contrasted the completed system with similar commercially available systems

Identified good features and shortcomings of the completed solution and described significant potential improvements that could be made to improve its effectiveness

- Evaluated their own strengths and weaknesses in the design and development of the system
- Described specific changes of approach that would be adopted in future to avoid problems experienced during the project

A few candidates were using this section to demonstrate their solution met all the original objectives, while this is useful it is not evaluative and could be included in testing. The expectation is the candidates should be self reflective in this section and fully analyse their own performance.



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