GCE EXAMINERS' REPORTS

GCE (NEW)
COMPUTER SCIENCE
AS/Advanced

SUMMER 2022

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COMPUTER SCIENCE

General Certificate of Education (New)

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Advanced Subsidiary/Advanced

UNIT 1

General Comments

The mean total for Unit 1 this series was approximately 42 out of 100 marks. This represents an increase since this unit was last examined in 2019.

The effect of the pandemic was particularly evident in pupils' literacy skills and their use of technical terminology.

Comments on individual questions/sections

Q.1 Around half of the available marks were awarded to candidates for this question on registers.

A significant number of candidates were unclear as to the role of the program counter and current instruction register in the fetch-decode-execute cycle.

Q.2 Around half of the available marks were awarded to candidates for this question on input and output devices.

For both methods, candidates too often failed to name an appropriate device. A common misconception is that a mobile phone is a suitable device which is too generic.

Q.3 A minority of the available marks were awarded to candidates for this question on network communications.

A few candidates were able to explain the role of multiplexing on a network.

Many candidates failed to describe fully the contents of a TCP/IP packet. Merely listing the contents was insufficient to be awarded credit.

Q.4 Around half of the available marks were awarded to candidates for this question on number representation.

A very few candidates were able to state the meaning of the term 'word'.

Many candidates were confident in converting between the different number counting systems and using binary addition. These candidates were also confident in using sign/magnitude and two's complementation to represent negative numbers.

Many candidates were able to convert a floating-point number into a real number. Fewer candidates were able to correctly determine the largest positive denary number and this was often because they had determined that the largest exponent is $111_2 = 7_{10}$, which is incorrect as the system uses two's complement, so $111_2 = -1_{10}$.

A minority of candidates were able to describe truncation, rounding and their affect upon accuracy. Many were able to determine that rounding is the most accurate method.

Q.5 A minority of the available marks were awarded to candidates for this question on fixed and variable length records.

Many candidates were able to explain that a fixed length record has same number of bytes in each record, whereas variable length record has different number of bytes in each record. They also stated that a fixed length record wastes storage space as fields have blank storage space, whereas variable length record saves storage space as no blank storage space.

A few candidates were able to give explanations in more depth than this.

Q.6 A minority of the available marks were awarded to candidates for this question on database views and archiving.

A minority of candidates understood that different user groups can have different access rights and privileges, and that this improves security. These candidates also described how certain fields can be hidden or set as read-only. Fewer candidates wrote about pre-defined complicated queries access to data spread over multiple tables.

A majority of candidates described the need for archiving files.

Q.7 Around half of the available marks were awarded to candidates for this question on algorithms.

Most candidates were able to correctly initialise variables. These candidates also input the username and password correctly.

Many candidates found the username and password comparison difficult and this was generally due to them incorrectly referencing the two-dimensional array.

Q.8 A minority of the available marks were awarded to candidates for this question on modes of operation.

A few candidates did not attempt this question.

Q.9 Around half of the available marks were awarded to candidates for this question on Boolean algebra.

A majority of candidates were able to expand the brackets during the simplification and were able to apply the complement rule correctly. Many candidates had errors in their simplification beyond this point.

Q.10 A majority of the available marks were awarded to candidates for this question on algorithm constructs.

Q.11 A few of the available marks were awarded to candidates for this question on programming paradigms. This was the worst answered question of the paper.

Around half of candidates were able to describe the procedural paradigm at superficial level. These candidates wrote about procedural languages being based on a logical step-by-step process for solving a problem and that they obey ordered instructions.

A minority of candidates were able to describe the mark-up paradigm at superficial level. These candidates wrote about mark-up languages using opening and closing HTML tags.

A few candidates did not attempt this question.

Q.12 Many of the available marks were awarded to candidates for this question on malicious and accidental damage. This was the best answered question of the paper.

Q.13 A minority of the available marks were awarded to candidates for this question on expert systems and their effect on employment.

Where candidates were familiar with expert systems, they were able to write an extended response that has a sustained line of reasoning. They also showed clear understanding of the requirements of the question and a clear knowledge of the indicative content.

Summary of key points

Candidates had a reasonably good understanding of malicious and accidental damage, algorithm constructs and Boolean algebra. They performed best in these questions.

Candidates found the questions on programming paradigms, expert systems and their effect on employment, and database views and archiving files challenging, and this was reflected in the low facility factor for these questions.

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UNIT 2

General Comments

Unit 2 is a practical examination with candidates required to demonstrate the application of knowledge and understanding at all times. It was pleasing to see the mean mark for the paper increase and more candidates demonstrate a better understanding of the practical applied programming aspect of computer science.

Comments on individual questions/sections

Part A:

Q.1 This was well answered by most candidates; however, some candidates could not identify key fields. The ER diagrams were largely clear and well presented however centres are reminded that candidates should clearly show the one-to-many relationships where needed.

Q.2 This question required candidates to justify their choice of software to implement a solution for the company in the scenario (e.g. KimsKarate) candidates use of technical terminology let them down on some occasions.

Q.3 A question on object oriented programming and modelling. This question was not as well answered with candidates finding differentiation between public, private and protected methods and attributes difficult.

Q.4 This algorithm question was assessed differently to previous years and was considered slightly more accessible as a result, despite it being a more demanding algorithm (binary search). The item level data for this question was therefore pleasing.

Part B:

1: This question was considered to be quite demanding as it had file handling and number handling combined. However performance was generally very good.

2: This question was made more demanding by expanding the depth of annotation and understanding required by candidates.

Summary of key points

Most of the candidates demonstrated a good understanding of the specification. Many candidates were well or very well prepared for programming and many excellent answers were evident. There was evidence also that some candidates had been well prepared for the majority of the practical programming elements found in section B, however, performance when using file handling code was again disappointing, and performance whilst annotating code was very variable.

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UNIT 3

General Comments

Most candidates were well prepared and demonstrated an expected standard of knowledge and application required for A2 given the candidates' distributed learning over the past two years. There was a wide range of answers with many candidates achieving higher marks in questions applying Boolean algebra and depicting truth tables. As mentioned, it is difficult to compare candidates' responses to previous years due to the disruption of learning caused by the pandemic. All questions were very well attempted by the candidates.

Comments on individual questions/sections

Q.1 Mean mark of 3.9 out of 8 with a facility factor of 48.8

Most candidates demonstrated a sound understanding of stacks and two-dimensional array data structures. In part (a) candidates responded with very good examples of the use of a stack e.g. an undo feature in a piece of software. Some candidates provided examples which were not technical or contextualised enough to award the mark e.g. a stack of plates. Marks were often lost due to candidates not fully describing the operation of the data structures, just stating the FILO principle without expanding on their operations. Some candidates also did not give technical descriptions of these operations just stating the terms pop and push etc. Part (b) was well answered by candidates although at times they missed the indices when demonstrating a two-dimensional array in part (b) ii.

Q.2 Mean mark of 3.6 out of 8 with a facility factor of 45.2

The question was well answered by candidates with the majority being able to fully define the term algorithm. In part (b) some candidates did not go on to fully describe the method for defining the algorithm and only stated the term e.g. pseudocode or flowcharts. Part (c) showed to be a discriminator of higher-level candidates with many stating suitable drawbacks and benefits of a recursive and non-recursive algorithm.

Q.3 Mean mark of 6.5 out of 11 with a facility factor of 58.7

As in previous years, the questions on the Boolean algebra question were well answered, and many candidates simplified their expressions to their simplest form using a variety of methods. Candidates are reminded that they should check their answers methodically. Some candidates correctly applied many Boolean algebraic identities although arrived at the incorrect answer due to a single misapplication at an earlier stage.

Q.4 Mean mark of 3.4 out of 8 with a facility factor of 42.7

The question was well attempted and answered by most candidates. Many candidates demonstrated the full binary search algorithm either recursively or non-recursively. Some candidates provided the wrong algorithm although many of these were still awarded marks for variable declaration and use of iteration etc. Centres should be encouraged to utilise the algorithms provided in previous series' marking schemes as learning materials to prepare candidates.

Q.5 Mean mark of 3.0 out of 8 with a facility factor of 37.4

The question proved demanding for many candidates as it required them to dry run an algorithm, fully describe its purpose, and identify its outputs. Most candidates identified the algorithm as a calculation of the digit sum of a number although did not mention the validation within their explanations i.e. must be a number between 100 and 999.

Q.6 Mean mark of 3.8 out of 12 with a facility factor of 31.4

The question proved demanding for many candidates with a lower accessibility rating.

In part (a) many candidates answered the question too broadly by describing the features of the entire Waterfall and Agile software development methodologies without contextualising or primarily focusing on the analysis and design stages. Candidates should be reminded to fully read and comprehend each question before writing a response.

In part (b) many candidates answered the question with suitable documentation produced in the software development lifecycle. However, again, candidates did not provide a suitable description of what documentation is specifically produced during the analysis and maintenance stages.

Q.7 Mean mark of 4.0 out of 6 with a facility factor of 66.2

The question was well answered by the majority of candidates, with many getting 4 marks. candidates are very familiar with BNF as it has appeared frequently in previous papers. Many candidates only were awarded 4 marks as failed to include both separators or the correct range of digits for each individual part.

Q.8 Mean mark of 0.4 out of 6 with a facility factor of 6.0

The question was significantly inaccessible to candidates with the vast majority receiving low to zero marks. The question asked candidates to explain both functional and logic programming and provide an example use and language for each. This has not been asked in a previous series which could be highly indicative of the significantly low facility rating. The qualification specification includes 'Describe the distinguishing features of different types of programming paradigms, including procedural, event-driven, visual and mark-up languages.' This does not explicitly state functional and logic paradigms which could have meant it may not have been taught in centres as those candidates who did respond well did so on a centre-by-centre basis.

Q.9 Mean mark of 1.1 out of 4 with a facility factor of 26.8

The question proved demanding for many candidates with a lower accessibility rating than the average item on the paper. Many candidates explained that if languages are standardised then learning a language would be easier if a person was already proficient in another. This response is generic and not in context with what is meant by the technical term standardisation of languages. In part (b) many candidates again provide generic non-technical responses which were not relevant to the context of the question.

Q.10 Mean mark of 2.6 out of 4 with a facility factor of 72.8

The question on drawing truth tables was well answered by most candidates. Candidates are clearly well versed in producing truth tables which means it is being taught well by centres and fully understood by candidates. Candidates seem to have responded better to the technical/mathematical items on the paper such as truth table and Boolean algebra over the explanation and description items.

Q.11 Mean mark of 2.4 out of 9 with a facility factor of 26.8

The question required candidates to evaluate an algorithm using Big O notation. The question proved to be challenging for most candidates with a low average mark. The format of this item has appeared frequently in previous papers.

In part (a) some candidates who were able to identify the algorithm as polymorphic / $O(n^3)$, went on to describe and evaluate the algorithm well. Most candidates stated $O(n^2)$ which has frequently been the answer to many other algorithms provided in previous papers.

Part (c) was more well answered than part (a) with the majority of candidates determining the correct growth rate. This could be because the correct response is like that seen in similar questions in previous papers.

In part (c), most candidates could correctly draw both axis and the time performance.

Question 12 – mean mark of 1.3 out of 4 with a facility factor of 33.2

The question was well answered by the many candidates, with many getting 1 - 2 marks.

Again, like previous items in the paper candidates failed to fully articulate and describe the methods they were stating of how data may be recovered if lost. Candidates need to fully expand their responses to access the full range of marks available.

Q.13 Mean mark of 4.1 out of 12 with a facility factor of 34.0

This question required candidates to describe and give examples of different translators and distinguish between them. Few candidates achieved high marks on this question. Most candidates were awarded marks for outlining their generic knowledge of codes of conduct and software development methodologies separately. Fewer candidates then went on to discuss the importance of codes of conduct in the context of software development stages. Centres are encouraged to ensure candidates can suitably structure a response to extended answer questions using in-depth knowledge, technical terminology and supporting real-world examples.

Summary of key points

Candidates should be encouraged to include more technical terminology when answering knowledge-focused questions such as the question on codes of conduct during the software development stages. Centres should also encourage a deeper understanding of topics such as programming paradigms and ensure candidates fully read and comprehend the context of the questions when applying their knowledge.

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UNIT 4

General Comments

The examinations were completed after some streamlining of content which removed three distinct topic areas from the assessment. Marking was carried out with consideration of the exceptional circumstances leading up to the examination and final grade boundaries were based on the initial recommended boundaries put forward following statistical analysis of candidate performance.

Many candidates were well prepared and demonstrated a wide knowledge of the topics in the specification. As in previous series good answers were seen for questions requiring precise answers to programming or mathematical problems, whereas in descriptive questions, candidates sometimes provided answers which were correct in general terms but lacked sufficient detail to gain high marks.

Comments on individual questions/sections

Q.1 Intended to provide an accessible start to the paper, with most candidates providing clear descriptions of file organisation. In part (b) several candidates failed to concentrate on the purpose of a hashing algorithm, as required.

Q.2 Priorities and procedures for dealing with interrupts. Most candidates were confident with this topic and were able to produce an accurate response to the priority process as required in part (b).

Q.3 Assembly language programming. A familiar topic where most candidates were able to provide a logical sequence using the instruction set provided.

Q.4 Communication applications. Introduced to cover an area of the specification not previously tested in any detail. Most candidates were able to gain some marks based on their own experiences with the applications listed.

Q.5 Floating point representation. The majority of candidates produced accurate representations and calculations, as required, and many demonstrated clear understanding when describing the relationship between the mantissa and exponent.

Q.6 Network costs. The majority of candidates produced accurate calculations of lowest cost routes. Several candidates found the supplementary question (b)(ii), which required some broader interpretation, to be more challenging.

Q.7 Cyber-attack vectors. The majority of candidates produced clear explanations of the term ‘cyber-attack vector’, as required. Fewer candidates were able to describe two additional cyber-attack vectors, with descriptions of viruses being the most common response.

Q.8 Penetration testing. The statements of meaning required for part(a) were generally well done. In part (b) candidates tended to concentrate on white hat / grey hat hackers rather than describe any specific strategies.

Q.9 Writing SQL commands. A familiar and accessible topic. Most candidates were able to form well-structured and accurate commands using precise syntax as required.

Q.10 Relational databases, advantages and design. This also proved to be a familiar and accessible topic, and an opportunity, taken by most candidates, to gain high marks.

Q.11 Parallel processing. Most candidates produced accurate calculations of increases in speed, using the given formula. Pat (b) was found to be more challenging where many candidates did not discuss the effect of processing with differing parallel fractions, or consider the limitation imposed by the serial fraction on the potential of parallelisation.

Q.12 Distributed databases. The question provided 4 marks for two advantages described. Most candidates gave responses based on reliability and the modular nature of these systems and very few references to response times or communication costs were seen.

Q.13 Asymmetric encryption. Many candidates demonstrated some knowledge of public and private keys. The most successful candidates compared the two methods identified in the question and described advantages arising from the improved security associated with asymmetric encryption.

Q.14 Biometric security technologies. The question was band marked with four main areas identified in the indicative content of the mark scheme. Most candidates were able to describe a range of biometric devices, but few covered process stages, levels of accuracy or the specific context of the question to produce an extended explanation of associated benefits and drawbacks.

Summary of key points

Programming, calculation and database questions were generally well answered.
In descriptive questions, candidates can often clarify their responses and gain additional credit for describing specific computing applications.

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UNIT 5

General Comments

Administration

Many projects of a good standard were submitted for moderation this summer. Moderators saw some work of an excellent standard. Many centres had assessed the work accurately and had clearly explained their assessment decisions which aided the moderation process. All candidate work was uploaded correctly as per the specification. 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. In too many instances, moderators found that solutions included absolute rather than relative pathways to files that prevented the solutions from functioning correctly.

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 68999, candidate number 12345) would store her work in a folder named 68999_12345_SM_D. In addition, candidates should ensure that they have linked their work to the GCE Computer Science Unit 5 Task sheet (U5e). It is an essential requirement that all candidate work is authenticated, and the authentication sheets are uploaded with the candidates' work. There were some instances were this was not the case, which then required moderators to and WJEC officers to contact centres to request 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.

Candidates' work

The following information is provided to help centres guide candidates through the NEA in future. There was evidence of some confusion regarding the following sections of the project work.

In general, many centres do not appear to have recognised the importance of the discussion section for the identification of suitably substantive problem situations. 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.

During design work candidates should identify the objectives for their problem solutions. These objectives should inform all sections of the candidates' work from this point onwards.

For each objective, candidates should:

- Design input and output facilities and appropriate data structures
- Produce algorithms for processing
- Fully develop the solution
- Testing should cover each objective
- Evaluation of the solution for each objective

In some cases, candidates produced final solutions that were over reliant on application packages such as relational databases and spreadsheets. This qualification does not allow the use of such applications other than as a vehicle for storage of files. Candidates should not make use of any of the facilities built into the application and all validation of data and sorts/searches of sets of data must be implemented through the creation of original code.

Centres should ensure that where candidates' solutions require the use of usernames and passwords that this information is included on the candidates' mark sheets or in a 'readme' document stored with the functional solution. It is essential that moderators are able to run the candidates' solutions to fairly assess the appropriate marks for the work. In some instances, the only way to locate the username and passwords for the solution was to search through the testing section, making the moderation process harder.

Comments on individual questions/sections

Discussion

It is important that centres recognise the importance of the discussion section. This section provides opportunities for the candidates to present their problem situations to their teacher, peers and/or other competent third parties. 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. In many cases candidates feedback was limited with little or no response to the feedback.

The preparation of the materials for the presentation/discussion provides opportunities for the candidates to reflect on their ideas and the problem situation. If necessary, the candidates can reframe their problem situation or even identify a different, more appropriate problem situation.

Investigation

Where candidates had chosen suitable real-life problems, they have the opportunity to carry out an investigation into the current system. Candidates should identify the data collected, processed and output by the current system. In many cases candidates did not carry out this investigation and analysis but provided narrative accounts of problem situations that did not allow them to identify suitable objectives for their solutions nor form the basis for a comprehensive design. However, it is recognised that some methods of investigation may have been more difficult during this series, due to covid restrictions.

All candidates are required to carry out desk-based research into similar commercial solutions created to solve similar problems. In many instances, candidates are paying only lip service to this requirement. 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. This is intended to provide them with informed ideas for further development of their systems.

Where candidates are not able to identify a real-life problem, 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. It is important that candidates produce a comprehensive working specification and that measurable objectives are set that will inform the design, prototyping and testing processes.

Design

The design stage is an opportunity to effectively plan and develop the technical elements of the functional solution before its implementation. This should be forward-thinking and include a range of elements, including:

- Designs of screen layouts
- Consideration of all forms of inputs and outputs required
- Evidence of all data structures with methods of access
- Consideration of data validation
- Design of programming routines for the functional solution using a recognised convention such as pseudocode or flowcharts.

Many centres included most elements of the design section, however, there were centres that did not effectively utilise this opportunity to thoroughly design the solution to the problem.

Some design work lacked the technical content required by the specification. With candidates not always presenting the processing stages of their proposed solution either in pseudo code, flowcharts or another recognised convention. Some centres used screen shots of already developed code as a way of considering the processing stages. Not all centres considered effective methods of access or depth of data validation.

Software Development

To access the higher mark bands all programs should fully exploit the language, using advanced programming features and well-structured data normalised to 3NF, this was not always evident. There should be examples of effective searching and sorting at the programming end and output content as requested by the user. The system should aim to cover all the objectives identified and fully exploit the programming facilities of the language. Many solutions had limited validation methods, but did cover basic validations for some key components.

It is a requirement of this section to provide evidence of the completed user interface with discussion of the features that make it fit for audience and purpose, however this was often lacking in the software development section. Often the program contained some self-documenting identifiers, however this is was not there for all variables and structures.

Testing

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 work 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.

Evaluation

The evaluation section should cover the effectiveness of the programming language and a justification of the tools and techniques used.

Candidates should then compare and contrast their completed solutions with the commercial systems considered during the investigation section of the work. This comparison should allow candidates to identify and discuss the good features and shortcomings of their work. It is important that candidates describe significant potential improvements to their systems that would more reflect the facilities of the commercial solutions to the chosen problem.

Candidates should also consider their own strengths and weakness and how they would adapt their approach to improve their performance if faced with a similar task in the future. Many candidates showed strengths in some areas during the evaluation stage, but did not cover all areas of the requirements.

Adaption

Due to the current circumstances the removal of two sections was put in place during the awarding season. The section of Prototype and Post-prototype Refinement and Design. This meant that candidates had to complete less content during the software development and testing phases in order to complete a functional system.

Summary of key points

Most candidates had chosen suitable problem situations as a basis for their project work. These problem situations would provide them with enough scope to produce a fully working system at an appropriate level for this qualification although this was not always fully exploited.

However, a minority of candidates had chosen problem situations that did not provide the opportunities for data handling that are required to access marks for design, implementation and testing at a level appropriate for this qualification. It is not appropriate for candidates to undertake problem situations that involve the creation of games or quizzes.

The specification has been designed to provide two opportunities for feedback from teachers, competent third parties and peers that should have encouraged these candidates to refine or change their choice of problem as they will not be able to access the full range of marks.

Candidates should consider whether their choice of problem situation provides them with sufficient:

- Opportunities to carry out an investigation in appropriate depth to provide evidence to
- allow them to complete the analysis, problem definition and objectives sections of the
- work to an appropriate level of complexity for an A2 qualification.
- Complexity to provide the opportunities needed to access the full range of marks
- Data handling process to allow thorough testing processes to take place

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