GCSE

eduqas
Part of WJEC

WJEC Eduqas GCSE in COMPUTER SCIENCE

ACCREDITED BY OFQUAL

SPECIFICATION

Teaching from 2016
For award from 2018

Version 3 January 2019

wjec
cbac

This Ofqual regulated qualification is not available for candidates in maintained schools and colleges in Wales.

SUMMARY OF AMENDMENTS

Version	Description	Page number
2	Amendments made to clarify that the programming project is unweighted	Throughout
3	'Making entries' section has been amended to clarify resit rules.	20

WJEC Eduqas GCSE (9-1) in COMPUTER SCIENCE

For teaching from 2016
For award from 2018

GCSE COMPUTER SCIENCE

SUMMARY OF ASSESSMENT

Component 1: Understanding Computer Science
Written examination: 1 hour 45 minutes
62.5% of the qualification

This component investigates hardware, logical operations, communication, data representation and data types, operating systems, principles of programming, software engineering, program construction, security and data management and the impacts of digital technology on wider society.

Component 2: Computational Thinking and Programming
On-screen examination: 2 hours
37.5% of the qualification

This component investigates problem solving, algorithms and programming constructs, programming languages, data structures and data types and security and authentication.

Component 3: Software Development
Programming project: 20 hours
Unweighted

This component requires learners to produce a programmed solution to a problem. They must analyse the problem, design a solution to the problem, develop a final programmed solution, test the solution and give suggestions for further development of the solution. Throughout the production of the solution learners are required to produce a refinement log that evidences the development of the solution.

This component does not contribute to the final mark or qualification grade.

This linear qualification will be available in the summer series each year. It will be awarded for the first time in Summer 2018.

Qualification Accreditation Number: 601/8291/X

GCSE COMPUTER SCIENCE

1 INTRODUCTION

1.1 Aims and objectives

The WJEC Eduqas GCSE in Computer Science encourages learners to:

- understand and apply the fundamental principles and concepts of computer science, including abstraction, decomposition, logic, algorithms, and data representation
- analyse problems in computational terms through practical experience of solving such problems, including designing, writing and debugging programs to do so
- think creatively, innovatively, analytically, logically and critically
- understand the components that make up digital systems, and how they communicate with one another and with other systems
- understand the impacts of digital technology to the individual and to wider society
- apply mathematical skills relevant to computer science.

Computers are widely used in all aspects of business, industry, government, education, leisure and the home. In this technological age, a study of computer science, and particularly how computers are used in the solution of a variety of problems, is essential to learners.

Computer science integrates well with subjects across the curriculum. It demands both logical discipline and imaginative creativity in the selection and design of algorithms and the writing, testing and debugging of programs; it relies on an understanding of the rules of language at a fundamental level; it encourages an awareness of the management and organisation of computer systems; it extends learners' horizons beyond the school or college environment in the appreciation of the effects of computer science on society and individuals.

The WJEC Eduqas GCSE in Computer Science has been designed to give an understanding of the fundamental concepts of computer science and a broad scope of study opportunities. This specification has been designed to free centres to concentrate on innovative delivery of the course by having a streamlined, uncomplicated, future-proof structure, with realistic technological requirements.

1.2 Prior learning and progression

Although there is no specific requirement for prior learning, this specification builds on the knowledge, understanding and skills established through the computer science elements of the computing programme of study at Key Stage 3 and enables learners to progress into further learning and/or employment.

This specification provides a suitable foundation for the study of computer science at AS and A level. In addition, the specification provides a coherent, satisfying and worthwhile course of study for learners who do not progress to further study in this subject.

In addition this specification is not age specific and, as such, provides opportunities for learners to extend their life-long learning.

1.3 Equality and fair access

This specification may be followed by any learner, irrespective of gender, ethnic, religious or cultural background. It has been designed to avoid, where possible, features that could, without justification, make it more difficult for a learner to achieve because they have a particular protected characteristic.

The protected characteristics under the Equality Act 2010 are age, disability, gender reassignment, pregnancy and maternity, race, religion or belief, sex and sexual orientation.

The specification has been discussed with groups who represent the interests of a diverse range of learners, and the specification will be kept under review.

Reasonable adjustments are made for certain learners in order to enable them to access the assessments (e.g. candidates are allowed access to a Sign Language Interpreter, using British Sign Language). Information on reasonable adjustments is found in the following document from the Joint Council for Qualifications (JCQ): *Access Arrangements and Reasonable Adjustments: General and Vocational Qualifications.*

This document is available on the JCQ website (www.jcq.org.uk). As a consequence of provision for reasonable adjustments, very few learners will have a complete barrier to any part of the assessment.

2 SUBJECT CONTENT

This specification promotes the integrated study of computer science. It will enable learners to develop a broad range of skills in the areas of programming, system development, computer architecture, data, communication and applications.

The knowledge, understanding and skills are set out in the two columns in the pages that follow. The topic to be studied is in the first column, with the amplification in the second column. There is no hierarchy implied by the order in which content and amplification are presented, nor should the length of the various sections be taken to imply any view of their relative importance.

The subject content for GCSE Computer Science will be assessed across three components. Whist there is a degree of overlap between the content in Component 1 and Component 2, the context in which this content is assessed differs. In Component 1, content is assessed in a theoretical way, whereas in Component 2 it is assessed through its use within programs and algorithms.

Component 1: Understanding Computer Science
Written examination: 1 hour 45 minutes
62.5% of the qualification
100 marks

Component 2: Computational Thinking and Programming
On-screen examination: 2 hours
37.5% of the qualification
60 marks

Component 3: Software Development
Programming project: 20 hours
Unweighted

2.1 Component 1

1. Hardware

Architecture	Describe the characteristics of CPU architecture, including Von Neumann architectures. Identify and explain the role of the components of the CPU in the fetch-decode-execute cycle. Explain how performance is affected by the cache size, clock speed and number of cores. Explain the difference between RISC and CISC types of processors.
Input/output	Describe the use and characteristics of input and output devices.

Primary storage	Explain the functional characteristics of Random Access Memory (RAM), Read Only Memory (ROM), flash memory and cache memory.
Secondary storage	Describe the characteristics of contemporary secondary storage technologies including magnetic, optical and solid state. Explain the functional characteristics of contemporary secondary storage devices in terms of suitability, durability, portability and speed.
Storage requirements	Describe the relationship between data storage units, including bit, nybble, byte, kilobyte and additional prefix multipliers. Describe data capacity and calculate data capacity requirements.
Additional hardware components	Describe the characteristics and role of additional hardware, including GPU, sound cards and motherboards.
Embedded systems	Describe the use and give examples of embedded systems.

2. Logical operations

Logical operators	Use `AND`, `OR`, `NOT` and `XOR` logical operators, combinations of these, and their application in appropriate truth tables to solve problems.
Boolean logic	Simplify Boolean expressions using Boolean identities and rules.

3. Communication

Networks	Explain the characteristics of networks and the importance of different network types, including LAN and WAN. Describe the importance of common network topologies, including ring, star, bus and mesh, and their advantages and disadvantages. Explain the importance of connectivity, both wired and wireless. Explain and give advantages and disadvantages of circuit switching and packet switching. Explain the importance and the use of a range of contemporary network protocols, including Ethernet, Wi-Fi, TCP/IP, HTTP, HTTPS, FTP and email protocols.

	Describe the typical contents of a TCP/IP packet.
	Explain the importance of layers and the TCP/IP 5-layer model.
	Describe methods of routing traffic on a network and calculate routing costs.
Internet	Explain how Domain Name System (DNS) servers and Internet Protocol (IP) addresses work.

4. Organisation and structure of data

Representation of numbers	Use and convert between denary, binary (up to 16 bits) and hexadecimal counting systems.
	Explain the use of hexadecimal notation as shorthand for binary numbers.
	Use arithmetic shift functions and explain their effect.
	Apply binary addition techniques.
	Explain the concept of overflow.
Representation of graphics and sound	Explain the digital storage of graphics.
	Explain the digital storage and sampling of sound.
	Describe the use of metadata in files.
Storage of characters	Describe how characters are stored as a binary number.
	Describe standardised character sets, including Unicode and American Standard Code for Information Interchange (ASCII).
Data types	Describe the concept of data types, including integer, Boolean, real, character and string.
Data structures	Describe, design, interpret and manipulate data structures including records, one-dimensional and two-dimensional arrays.
	Select, identify and justify appropriate data structures for given situations.
File design	Design files and records appropriate for a particular application.
Data validation and verification	Explain and use appropriate techniques for data validation and verification.
	Design algorithms and programming routines that validate and verify data.

5.	**Operating systems**	
	Managing resources	Describe the purpose and functionality of the operating system in managing resources, including peripherals, processes, memory and backing store.
	Providing an interface	Describe the purpose and functionality of the operating system in providing a user interface.
	Utility software	Explain the purpose and functionality of a range of utility software.
6.	**Principles of programming**	
	Levels of computer language	Describe the characteristics and purpose of high-level and low-level languages. Identify and describe situations that require the use of a high-level or a low-level language.
7.	**Software engineering**	
	Software tools	Explain the role of Integrated Development Environment (IDE) tools in developing and debugging programs.
8.	**Program construction**	
	Compilers, interpreters and assemblers	Describe the purpose and give examples of the use of compilers, interpreters and assemblers. Explain the principal stages involved in the compilation process: lexical analysis, symbol table construction, syntax analysis, semantic analysis, code generation and optimisation. Describe and give examples of programing errors.
9.	**Security and data management**	
	Data security	Describe the dangers that can arise from the use of computers to store personal data. Describe methods that protect the security of data including access levels, suitable passwords for access and encryption techniques.
	Data management	Explain the need for file backups and generations of files. Explain the need for archiving files.
	Compression	Explain how lossy and lossless data compression algorithms are used. Calculate compression ratios.

Network security	Recognise the importance of network security and describe the dangers that can arise from the use of networks. Explain the purpose and typical contents of an acceptable use policy and disaster recovery policy.
Cybersecurity	Describe the characteristics and explain the methods of protection against malware, including viruses, worms and key loggers. Describe the different forms of attack based on technical weaknesses and/or user behaviour. Describe methods of identifying vulnerabilities. Explain different ways of protecting software systems during design, creation, testing and use. Describe the role of internet cookies.

10. Ethical, legal and environmental impacts of digital technology on wider society

Ethical	Describe the ethical impacts of digital technology, including issues of privacy and cybersecurity. Explain the importance of conforming to professional standards, including formal and informal codes of ethical behaviour.
Legislation	Explain how relevant current legislation impacts on security, privacy, data protection and freedom of information.
Environmental issues	Describe the environmental impacts of digital technology on wider society.

2.2 Component 2

1. Problem solving

Problem solving	Use a systematic approach to problem solving including the use of decomposition and abstraction. Use abstraction effectively to model selected aspects of the external world in an algorithm or program. Use abstraction effectively to appropriately structure programs into modular parts with clear, well-documented interfaces.

2. Algorithms and programming constructs

Algorithms	Use common methods of defining algorithms, including pseudo-code and flowcharts *(see Appendix C)*.
Programming constructs	Identify, explain and use sub routines in algorithms and programs. Identify, explain and use sequence, selection and iteration in algorithms and programs. Identify, explain and use counts and rogue values in algorithms and programs. Identify and explain constructs in object orientated programs. Follow and make alterations to algorithms and programs that solve problems using: • sequence, selection and iteration • input, processing and output. Write algorithms and programs that solve problems using: • sequence, selection and iteration • input, processing and output.
Variables	Identify, explain and use local and global variables in algorithms and programs.
Identifiers	Explain why the use of self-documenting identifiers and annotation are important in programs. Give examples of self-documenting identifiers and annotation.
String handling	Identify, explain and use routines for string handling in algorithms and programs.

Mathematical operations	Identify, explain and apply computing-related mathematical operations in algorithms and programs (*see Appendix C*).
Logical operations	Identify, use and explain the logical operators `AND`, `OR`, `NOT` and `XOR` in algorithms and programs *(see Appendix C)*.
Sorting	Describe the characteristics of merge sort and bubble sort algorithms.
Searching	Explain and use linear and binary search algorithms.
Testing and evaluation	Explain how an algorithm or program works and evaluate its fitness for purpose in meeting requirements. Evaluate the efficiency of an algorithm or program using logical reasoning and test data.

3. Programming languages

Markup languages	Design, write, test and refine HTML pages using the following tags: • HTML `<html>` • Head `<head>` • Title `<title>` • Body `<body>` • Headings `<h1>` - `<h6>` • Paragraph `<p>` • Italic `<i>` • Bold `<b>` • Centre align `<center>` • Anchor `<a href="URL">` • Unordered List `<ul>` • List Item `<li>` • Blockquote `<blockquote>` • Horizontal Rule `<hr>` • Image `<img>` • and their corresponding closures.
Object oriented languages	Design, write, test and refine Java programs within the Greenfoot environment, using the following skills: • Create new and extend existing classes • Create new and edit existing objects • Create new and edit existing worlds • Write and invoke methods • Change existing methods

- Create new and edit existing properties (including public, private, static, etc.)
- Add and remove objects from worlds
- Use actors
- Move objects around a world
- Keyboard input
- Add and play sounds
- Implement and use parameter passing (by value and by reference)
- Access one object from another
- Implement object collision detection
- Implement random number generation
- Use the concept of inheritance and encapsulation.

Assembly language	Design, write, test and refine simple assembly programs using the following mnemonics:

- Input `INP`
- Output `OUT`
- Store `STA`
- Load `LDA`
- Add `ADD`
- Subtract `SUB`
- Branch `BRA`
- End/Stop/Halt `HLT`
- Data definition `DAT`

4. Data structures and data types

Implementing data structures	Use one-dimensional and two-dimensional arrays, files and records.
Implementing data types	Use a variety of data types, including integer, Boolean, real, character and string.
Variables and constants	Assign, identify and explain the use of constants and variables in algorithms and programs. Describe the scope and lifetime of variables in algorithms and programs.

5. Security and authentication

Security techniques	Use appropriate security techniques, including validation and authentication.

2.3 Component 3

The programming project is designed to develop a candidate's ability to apply the knowledge and understanding gained from Components 1 and 2. Candidates will be presented with a given scenario describing the requirements for a computer based solution. All work carried out for Component 3 should be under teacher supervision, with no access to the Internet or email.

Candidates will be required to create a solution to the given scenario using the logical and systematic approach outlined below. Candidates will be required to analyse the given scenario, design, implement and test a solution to the given scenario and identify future developments that could be used to refine the outcome.

In addition candidates will be required to keep a refinement log as described below, explaining any issues encountered and resulting refinements to the original design.

Software Development

Scope of the problem	Analyse and describe the given scenario in terms of input, processing and output. Set objectives, including measurable success criteria for the proposed system.
Design	Design and document the input and output facilities required to produce an effective user interface. Design and document all required data structures. Using a standard convention such as pseudo code or flowcharts, design and document the following routines: • validation • data handling and processing • authentication
Refinement Log	Plan to carry out activities in an appropriate order. Evaluate the progress made in each session. Describe any problems encountered using appropriate technical language. Justify any changes made to the original design as a result of problems encountered. Produce a logical plan of action for further sessions.

Effectiveness of solution	Create a solution that fulfils the requirements of the given scenario.
	Create an intuitive interface that is fit for audience and purpose.
	Ensure that the solution is well-structured and modular in nature.
	Ensure that the solution makes effective use of resources and is secure, robust and reliable.
Technical quality	Create code for the solution that is self-documenting, uses meaningful identifiers and appropriate constants.
	Use a program style that is consistent, including indentation and appropriate use of white space.
	Use subroutines with well-defined interfaces.
	Use local and global variables.
	Create validation and authentication routines.
	Annotate code so that it is accessible to a competent third party.
Test strategy	Design and document an effective testing strategy that will ensure that the final solution meets the requirements of the given scenario.
	Describe the purpose of unit, integration and functional testing.
	Describe how the outcomes of the testing process can be used to inform further development of the solution.
	Design a comprehensive plan for carrying out unit, integration and functional testing to cover all the requirements of the given scenario.
	Design test data to include examples of typical, extreme and erroneous content.
Testing	Implement the comprehensive test plan using typical, extreme and erroneous data where appropriate.
	Present all test outcomes with detailed and informed commentaries.
Further development	Consider the outcomes of the testing process in terms of the system objectives.
	Describe successful features and areas for improvement.
	Propose suggestions for specific extensions to the solution.

3 ASSESSMENT

3.1 Assessment objectives and weightings

Below are the assessment objectives for this specification. Learners must:

AO1
Demonstrate knowledge and understanding of the key concepts and principles of computer science

AO2
Apply knowledge and understanding of key concepts and principles of computer science

AO3
Analyse problems in computational terms:

- to make reasoned judgements
- to design, program, evaluate and refine solutions

The table below shows the weighting of each assessment objective for Component 1 and Component 2 and for the qualification as a whole. Whilst the programming project (Component 3) addresses mainly AO3 skills, no weightings are allocated to this component as it does not contribute to the final mark or qualification grade.

	AO1	AO2	AO3
Component 1	32.5%	30%	-
Component 2	5%	17.5%	15%
Total	**37.5%**	**47.5%**	**15%**

3.2 Arrangements for Component 2 on-screen examination

This assessment will be carried out in accordance with the instructions set out in 'Instructions for conducting on-screen tests', Appendix 1 of *General and Vocational Qualifications: Instructions for conducting examinations* (Joint Council for Qualifications). This document is available on the JCQ website (www.jcq.org.uk).

Programming language for Component 2

Some tasks in Component 2 will require work to be completed using Greenfoot, which is an integrated development environment (IDE) freely available for legal download. (http://www.greenfoot.org/door)

WJEC Eduqas will supply a paper copy of the assessment tasks and files for each candidate.

Candidates will need access to a computer with:

- a 'clean' user area or storage device on which to save their work
- no access to the Internet or email
- access to a word processor or similar software to produce their responses
- a functional copy of Greenfoot version 2.4.2 pre-installed.

The practical assessment should be carried out under formal supervision, i.e. the candidates must be in direct sight of the supervisor at all times. Use of resources is tightly prescribed and interaction with other candidates is forbidden.

3.3 Arrangements for Component 3 programming project

This specification includes a programming project. This is a substantial piece of work, undertaken over an extended period of time. The sample assessment material provides an example of a Component 3 programming project.

Although the programming project in GCSE Computer Science does not form part of the final mark or the overall grade for the qualification, it is important that learners develop an understanding of programming and the skills required to carry out programming projects themselves.

There is no requirement for centres (or for WJEC) to mark the programming project. However, centres may use the marking criteria in Appendix B to assess learners' work and provide feedback to learners if they wish.

A sample of candidates' programming projects will be submitted electronically for checking. WJEC will identify the sample to be submitted. The purpose of this check is to ensure:

- that each candidate has had the opportunity to undertake the programming project and has had 20 hours set aside in the timetable to allow them to undertake the project, and
- that their written accounts of their programming project represent their individual work, cover each part of the project and reference any resources used or support given.

A sample of centres will be inspected by a member of the JCQ monitoring team during the spring term of 2018 only; (i.e. during the first year that the reformed qualification is awarded). Inspection visits will check the processes in place in the centre for the delivery of the programming project.

The programming project requires candidates to analyse the scope of a problem, design a solution to the problem, implement a solution, design a test strategy, test the solution and give suggestions for further development of the solution. In addition candidates will be required to keep a refinement log as described in Component 3, explaining any issues encountered and resulting refinements to the original design.

The programming project will be set annually by WJEC Eduqas and published on the WJEC secure website. A task will have a shelf life of one academic year and will only be accepted for submission in the academic year of its publication. Tasks will be released each September from September 2017.

Candidates will develop a piece of work over 20 hours; produce a solution to a given problem and a word-processed report with an advisory limit of 2000 words detailing the work carried out. The 2000 word count does not include the program code or annotation.

The work for Component 3 must include the development of software in either a general purpose or a special purpose high-level language. The system proposed by the candidate may consist of one integrated program or a suite of related programs.

WJEC Eduqas will support the following languages:

- Basic derived languages (e.g. VB.NET, Small Basic, QBasic)
- C derived languages (e.g. C, C++, C#)
- PHP
- Python
- Pascal/Delphi

Optional assessment grids

There is no requirement for teachers to mark the programming project. However, optional assessment grids are provided in Appendix B. These are designed to present a system that links the assessment objectives to marks, and to help discriminate clearly between varying levels of achievement. Teachers may use these assessment grids in order to provide feedback to learners, both during and at the end of the task. WJEC will not be collecting numerical marks for the programming project.

Submission of assessments

Candidate work for Component 3 must be submitted to WJEC electronically. Submission will be through the *SecureAssess* system.

The submission should include a functioning compiled version and a functioning uncompiled copy of the solution and supporting documents in portable document format (pdf).

The candidate may wish to use folders to organise their work for each section and must ensure that the folders are organised in such a way that will allow the teacher and WJEC to access the relevant pdf documents.

Statements

The Head of Centre is required to sign and submit the programming project declaration to WJEC, which confirms that the centre has taken reasonable steps to ensure that:

- each candidate has had to the opportunity to undertake the programming project;
- 20 hours has been set aside in the timetable to allow them to undertake the project;
- candidates' written accounts of their programing project represent their own work.

Additionally:

- the GCSE Computer Science teacher is required to sign the statement confirming that the candidate's work was conducted under the conditions laid out by the specification;
- all candidates are required to sign the statement confirming that the work submitted is their own.

Supervision and authentication

Unfair practice

Before the course starts, the teacher is responsible for informing candidates of WJEC's regulations concerning malpractice. Candidates must not take part in any unfair practice in the preparation of work for GCSE Computer Science. They must understand that to present material copied directly from books or other sources without acknowledgement will be regarded as deliberate deception. Centres must report suspected malpractice to WJEC.

If WJEC is satisfied that the regulations have been breached, the candidate may be disqualified from all subjects. Candidates will be required to certify that they have read and understood the regulations relating to unfair practice.

Supervision of work

Centres must assure WJEC that the programming projects submitted are the work of the candidates concerned. For Component 3, all work must be undertaken under the direct supervision of teachers. Candidates must work in a dedicated, 'clean' account, with no access to the internet or email.

The teacher responsible for the supervision of the candidate's work must complete a declaration that she/he is satisfied that the programming project submitted is that of the candidate concerned.

Centres entering candidates for GCSE Computer Science must accept the obligation to provide sufficient supervision to enable them to give an assurance that every step has been taken to ensure that the work submitted is that of the candidate concerned. When a candidate has need of assistance in completing a particular piece of work, such assistance should be given but the teacher must add appropriate comments on the Programming Project cover sheet.

The time spent working on the programming project should be recorded by the teacher as a log and this may be requested by WJEC in addition to the work submitted. The log should be monitored by the centre and candidates should not be allowed to exceed the 20 hours permitted for the programming project.

Collaboration control.

Learners must not work together in the development of their project. Should workstations be near each other in class, the supervising teacher must ensure that all work carried out by learners is done so independently.

Help files

Only the help files native to the programming language should be provided, where help files are online (e.g. Visual Basic.NET) the relevant help file image may be installed locally for access by the learner. Forums or sample code should not be made accessible to learners.

Learners may also use a clean copy of the pseudocode conventions used by WJEC (Specification Appendix C, page 32, Note 3). This can be installed on the learner's secure area. Where a learner wishes to use a hard copy of these conventions, these should be handed to the learner at the beginning of any session and collected at the end of the session. Notes may not be taken into or out of the controlled test session.

Should a centre wish to provide a written glossary to the syntax of a language, this is permitted, but it should only provide a high level guide on the use of syntax of the programming language. It must not give examples of segments of code or how to use the language. This can be installed on the learner's secure area. Where a learner wishes to use a hard copy of these glossaries, these should be handed to the learner at the beginning of any session and collected at the end of that session. Glossaries must not be taken into or out of the controlled test session and must be submitted with the candidate's work.

Use of libraries

Learners should avoid the use of pre-compiled units, libraries or modules in their project and should aim to construct the entire project from original code.
Where a library is used it must be pre-compiled. The learner should state the functionality from the library to be used in their programming project. The supervising teacher should only permit learners to use functionality that lies beyond the scope of a GCSE learner (for example a library function that sorts data would not be acceptable as this functionality is of the scope expected from a GCSE learner). The supervising teacher must ensure that learners do not use any additional functions beyond those permitted.

The learner must record the source of the library in their report and the function(s) used and supply an electronic version of the library with their program.

The supervising teacher must record details of the library and functions used in the candidate declaration.

Authentication

It is important that the programming project is monitored by centres to ensure that candidates' work is their own. All candidates are required to sign that the work submitted is their own and teachers are required to confirm that the work is solely that of the candidate concerned and was conducted under the required conditions.

A copy of the programming project cover sheet for each candidate's work will be provided by WJEC. It is important to note that all candidates are required to sign this form, and not merely those whose work forms part of the sample submitted to WJEC. Malpractice discovered prior to the candidate signing the declaration of authentication need not be reported to WJEC but must be dealt with in accordance with the centre's internal procedures.

Before any work towards the programming project is undertaken, the attention of candidates should be drawn to the relevant JCQ Notice to Candidates. This is available on the JCQ website (www.jcq.org.uk) and included in Instructions for Conducting Coursework. More detailed guidance on the prevention of plagiarism is given in Plagiarism in Examinations: Guidance for Teachers/Assessors, also available on the JCQ website.

4 TECHNICAL INFORMATION

4.1 Making entries

This is a linear qualification in which all assessments must be taken at the end of the course. Assessment opportunities will be available in the summer series each year, until the end of the life of this specification. Summer 2018 will be the first assessment opportunity.

A qualification may be taken more than once. Candidates must resit all examination components in the same series.

The entry code appears below.

WJEC Eduqas GCSE Computer Science: C500QS

The current edition of our *Entry Procedures and Coding Information* gives up-to-date entry procedures.

4.2 Grading, awarding and reporting

GCSE qualifications are reported as a grade on the scale from 9 to 1, where 9 is the highest grade. Results not attaining the minimum standard for the award will be reported as U (unclassified).

APPENDIX A

Programming project

Component 3 – Programming Project

Given Task
The task for Component 3 will be a scenario set by WJEC Eduqas that will be available for completion in the academic year of certification. A different scenario will be set for each academic year. All work carried out for this task should be under teacher supervision, with no access to the Internet or email. The time permitted for this task is 20 hours, and all time spent on the task should be monitored and logged by the centre as detailed in this specification.

The scenario will provide candidates with a description of a client's need for a new computer based solution to a given problem. In addition to a functional computer program, candidates will need to produce a word processed report with an advisory limit of 2000 words. The areas for inclusion in the report are covered in detail in the content for this component and are summarised below:

Section 1 – Scope of the problem
- Description of the given scenario in terms of input, processing and output
- Objectives, including measurable success criteria for the proposed system

Section 2 – Design
Descriptions of:
- Input and output facilities required to produce a user interface
- Data structures that will be required
- Documentation of the following routines using a standard convention (pseudo code or flowchart):
    - validation routines
    - data handling and processing
    - authentication

Section 3 – Software development
- Annotated listing(s) of all programming code
- Evidence of the user interface

Section 4 – Test strategy
- Description of the test strategy
- Description of the purpose of unit, integration and functional testing
- Test plan and test data

Section 5 – Testing
- Evidence of test outcomes with commentaries

Section 6 – Further development
- Discussion of the outcomes of the testing
- Description of the successful features of the solution and identification of areas for further development
- Suggestions for extensions to the solution

The Refinement Log

The refinement log is an integral part of the programming project and should be completed during each session. The purpose of the log is for candidates to demonstrate that they are working in a logical and systematic manner.

Candidates are expected to record any issues encountered and how these issues were addressed.

The refinement log is supplied as an electronic document and must be submitted with the computer program and the written report.

A sample log page is shown below.

Session 3	
Date	
Length of session	
Progress made in this session	
Problems encountered with the project	
Changes made to original designs as a result of problems	
Action plan for next session	
Project plan status (on time, ahead of time, behind time)	
Action plan to manage time	

APPENDIX B

Optional assessment grids for programming project

There is no requirement for teachers to mark the programming project. However, optional assessment grids are provided here and teachers may use these in order to provide feedback to learners. WJEC will not be collecting numerical marks for the programming project.

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.

Before marking, teachers should first read and annotate a learner's programming project to pick out the evidence that is being assessed. 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 work should be viewed holistically. Beginning at the lowest band, teachers should look at the appropriate section of the learner's project and check whether it matches the descriptor for that section's mark band. Teachers should look at the descriptor for that band and see if it matches the qualities shown in the learner's work for that section. If the descriptor at the lowest band is satisfied, teachers should move up to the next band and repeat this process for each band until the descriptor matches the work.

If a learner's work 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 work should be used to decide on the mark within the band. For instance if work is mainly in band 2 but with a limited amount of band 3 content, the work 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. Teachers should not seek to mark learners down as a result of small omissions in minor areas of their work.

Stage 2 – Deciding on the mark

Once the band has been decided, teachers can then assign a mark. WJEC has provided exemplar material already awarded a mark, and this should be used as reference material when assessing the work.

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

Where work is not credit worthy, that is, contains nothing of any significance to the project, or has been omitted, no marks should be awarded.

Component 3 – Programming Project

Band	Scope of the problem - AO3.1 Max 8 marks

4	**7 - 8 marks**
	The learner has:
	• Completed a thorough analysis of the given scenario identifying all:
	  ○ data required to create an effective solution
	  ○ processing to be carried out by the solution
	  ○ required outputs from the solution
	• Produced a detailed set of objective, that are measurable, that define clearly the tasks required to create effective and fully functional solution

3	**5 - 6 marks**
	The learner has:
	• Completed an analysis of the given scenario, with no significant omissions, identifying most of the:
	  ○ data required to create a functional solution
	  ○ processing to be carried out by the solution
	  ○ required outputs from the solution
	• Put forward objectives, most of which are measurable, that define the tasks to be carried out by the proposed solution

2	**3 – 4 marks**
	The learner has:
	• Carried out an analysis of the given scenario, identifying the basic:
	  ○ data required to create a working solution
	  ○ processing requirements to produce a working solution
	  ○ outputs from the solution
	• Set objectives, a minority of which are measurable, that describe the main tasks required to create a working solution

1	**1 - 2 marks** The learner has: • Carried out a superficial analysis of the given scenario that has only partially identified the input, processes and output required to produce a working solution • Put forward objectives for the solution in terms of tasks to be carried out. Not all objectives are measureable or appropriate to the solution.
0	**0 marks** Response not credit worthy or not attempted

Band	Design - AO3.2a Max 12 marks
4	**10 - 12 marks** The learner has: • Produced a comprehensive design that would allow a competent third party to create a solution that covers all stated objectives • Identified fully and described in detail the input and output facilities to be provided by the user interface which will be fit for purpose • Described all data structures required to create an effective solution, using correct technical terminology • Described fully the validation routines required to ensure that only appropriate data can be entered into the solution • Considered fully the need for authentication • Described all processing routines for an effective solution as algorithms using a standard convention such as pseudo code or flowcharts
3	**7 - 9 marks** The learner has: • Used the objectives for the solution to inform a design that will produce the facilities required to ensure that the solution is functional • Identified and described most of the input and output facilities to be provided by the user interface and has considered the needs of the user • Described most data structures required using appropriate terminology • Identified most inputs that will require validation and outlined proposals for implementing validation routines • Considered the need for authentication routines • Described most processing routines for the solution as algorithms using a standard convention such as pseudo code or flowcharts
2	**4 - 6 marks** The learner has: • Used the objectives for the solution as a basis for the design that will produce a solution that will achieve a majority of the required functionality • Identified the basic input and output facilities to be provided by the user interface • Identified the data structures required to produce a solution that is partially functional but carries out the basic requirements of the given scenario Identified several inputs that will require validation • Outlined the need for authentication processes • Described the basic processing routines for the solution as algorithms using a standard convention such as pseudo code or flowcharts. Some routines may be incorrect or incomplete.
1	**1 - 3 marks** The learner has: • Used the objectives for the solution as a basis for an outline design for a partial solution • Produced outline designs for the identified input and output facilities provided by the user interface • Outlined the key files and/or data structures required to produce a partial solution • Given consideration to possible validation of input data, which may not be accurate or appropriate • Partially outlined processing routines that may use a standard convention such as pseudo code or flowcharts. The descriptions may not be accurate or correct.
0	**0 marks** Response not credit worthy or not attempted

Band	Refinement Log - AO3.2c
	Max 5 marks
3	**4 - 5 marks** The learner has: • Demonstrated a structured approach to developing the solution • Carried out activities in an appropriate order • Evaluated effectively the progress made in each session • Provided a full description of any problems encountered with good use of technical terminology • Justified any changes that have been made to the original design demonstrating an informed understanding of the need for change • Produced logical and prioritised actions for subsequent sessions
2	**2-3 marks** The learner has: • Demonstrated a structured approach to developing the solution • Carried out activities in an appropriate order • Described the progress made in each session • Provided a description of any problems encountered with satisfactory use of technical terminology • Described any changes that have been made to the original design • Produced sensible actions for subsequent sessions
1	**1 mark** The learner has: • Outlined the progress made in most sessions • Described problems encountered but may lack the use of technical terminology • Outlined changes that have been made to the original design • Identified one or more activity for the next session
0	**0 marks** Response not credit worthy or not attempted

Band	Effectiveness of solution – A03.2b
	Max 15 Marks
5	**13 – 15 Marks** The learner has created a solution that is: • Correct and fulfils all the requirements of the given scenario • Usable with a user interface that is intuitive and fit for audience and purpose • Well-structured and modular in nature • Efficient in use of resources • Secure with effective authentication routines • Portable, reliable and robust
4	**10 – 12 Marks** The learner has created a solution that is: • Correct and fulfils most of the requirements of the given scenario. • Usable with a user interface that is functional and generally easy to use • Structured and modular in nature • Secure with authentication routines • Portable and generally robust
3	**7 – 9 Marks** The learner has created a solution that: • Achieves a majority of the requirements of the given scenario • Provides evidence of a functional user interface • Includes some elements of structured programming • Makes use of authentication routines • Is portable
2	**4 – 6 Marks** The learner has created a solution that: • Achieves the basic requirements of the given scenario • Includes a basic user interface that may not be fit for purpose • Includes a basic number of elements of structured programming
1	**1 – 3 Marks** The learner has created a solution that: • Partially achieves the requirements of the given scenario • Has a partially functional user interface
0	**0 Marks** Response not credit worthy or not attempted

Band	Technical Quality – A03.2b Max 20 Marks
5	**17 – 20 Marks** The learner has created a successful solution that covers all the requirements of the given scenario. The learner has: • Written code that is self-documenting, well-structured and modular in nature • Used a consistent programming style throughout, including indentation and the use of white space around operators and keywords • Made full use of meaningful identifiers and appropriate use of constants • Created subroutines with well-defined interfaces • Made effective use of local variables and minimised the use of global variables • Produced effective validation routines and created routines for exception handling • Provided informed annotation of the code where appropriate
4	**13 – 16 Marks** The learner has created a functional solution that covers most requirements of the given scenario. The learner has: • Written code that is self-documenting and modular in nature • Used a consistent programming style including indentation • Made use of meaningful identifiers and appropriate use of constants • Made use of local variables and minimised the use of global variables • Produced validation routines and created routines for exception handling • Provided effective annotation of the code where appropriate
3	**9 – 12 Marks** The learner has created a functional solution that covers the majority of the requirements of the given scenario. The learner has: • Written code that is self-documenting • Used a consistent programming style including indentation • Made use of meaningful identifiers and appropriate use of constants • Made use of local variables and generally minimised the use of global variables • Produced validation routines • Provided annotation of the code where appropriate
2	**5 – 8 Marks** The learner has created a solution that covers the basic requirements of the given scenario. The learner has: • Written code that includes some self-documentation • Used appropriate indentation • Made use of meaningful identifiers • Provided basic annotation of the code

1	**1 – 4 Marks** The learner has created a partial solution to at least one of the requirements of the given scenario. The learner has: • Made use of meaningful identifiers • Used indentation
0	**0 Marks** Response not credit worthy or not attempted

Band	Test strategy - AO2.1b
	Max 8 marks
3	**6 - 8 marks** The learner has: • Considered fully the nature of the solution when developing a well-structured test strategy • Provided an informed description of the scope and range of the chosen test strategy • Fully explained the purpose of unit, integration and functional testing, taking into account the nature of the solution • Considered in detail how the outcomes of the testing process will be used to influence any further development of the solution • Produced a comprehensive plan for carrying out unit, integration and functional testing to cover all requirements of the given scenario • Identified comprehensive test data to fully test the solution
2	**3 - 5 marks** The learner has: • Considered the nature of the solution when developing a test strategy • Provided a description of the scope and range of the chosen test strategy • Described the purpose of unit, integration and functional testing, taking into account the nature of the solution • Considered how the outcomes of the testing process may be useful in any further development of the solution • Produced a test plan to carry out unit, integration and functional testing of most of the requirements of the given scenario • Identified appropriate test data to test most functionality of the solution
1	**1 - 2 marks** The learner has: • Attempted to describe of the scope and range of the chosen test strategy • Identified the purpose of testing the solution • Produced a test plan to carry out the testing of the solution but the plan may not cover all key areas • Identified test data to partially test the solution
0	**0 marks** Response not credit worthy or not attempted

Band	Testing - AO3.2c
	Max 8 marks
3	**6 - 8 marks** The learner has: • Followed the test plan in a logical and systematic manner • Made effective use of typical, extreme and erroneous data • Presented all testing outcomes with detailed and informed commentaries
2	**3 - 5 marks** The learner has: • Used the test plan to carry out testing of the solution • Made use of realistic data to test all areas of the solution • Presented testing outcomes with suitably technical commentaries
1	**1 - 2 marks** The learner has: • Made use of data to test most areas of the solution that have been completed • Presented testing outcomes with brief correct commentaries
0	**0 marks** Response not credit worthy or not attempted

Band	Further development - AO3.2c
	Max 4 marks
3	**4 marks** The learner has: • Considered fully the outcomes of the testing process in terms of the solution objectives • Fully described the successful features and areas for further development • Proposed detailed and comprehensive suggestions for specific extensions to the solution
2	**2 - 3 marks** The learner has: • Considered the outcomes of the testing processes against the solution objectives • Identified successful features and areas for further development • Proposed specific suggestions for extensions to the solution
1	**1 mark** The learner has outlined: • Outcomes of the testing process • Suggestions for extension to the solution
0	**0 marks** Response not credit worthy or not attempted

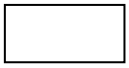
APPENDIX C

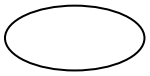
Conventions followed in specification

Note 1

Where Von Neumann architecture is represented diagrammatically, the following symbols are used:

Arithmetic logic unit 

Register 

Control unit 

Note 2

Where candidates are required to apply computing-related mathematics, the following arithmetical and relational operators will be used:

Operator	Meaning	Example
>	Greater than	A>B will return TRUE if the value of A is higher than the value of B otherwise it will return FALSE.
<	Less than	A<B will return TRUE if the value of A is lower that the value of B otherwise it will return FALSE.
<=	Less than or equal to	A<=B will return TRUE if A is the same as or lower than B otherwise it will return FALSE.
>=	Greater than or equal to	A>=B will return TRUE if A is the same as or higher than B otherwise it will return FALSE.
<>	Not equal to	A<>B will return TRUE if A is not the same as B but FALSE if A is the same as B.
EQUALS (usually ==)	The same as	A==B will return TRUE if A is the same as B otherwise it will return FALSE.
AND	Both statements must be true for the argument as a whole to be true.	(A == 1) AND (B==4) will return TRUE if A is 1 and B is 4. It would return FALSE in all other situations.
OR	Only one of the statements needs to be true for the argument as a whole to be true.	(A==1) OR (B==4) will return TRUE if A is 1 or B is 4. It would only return FALSE if A is not 1 and B is not 4.
NOT	The opposite of	NOT(A) will return TRUE if A is FALSE and FALSE if A is TRUE.

XOR	The argument is false if both statements are true. The argument is false if both statements are false. Otherwise the statement is true.	A XOR B would return TRUE if A and B are different values.
DIV	Integer division Finds the quotient or the 'whole number of times' a divisor can be divided into a number.	11 DIV 2 = 5 The quotient is 5 as 2 divides into 11 a whole number of 5 times
MOD	Modulo division Finds the remainder when a divisor is divided into a number.	11 MOD 2 = 1 The remainder is 1 as 2 divides 5 times into 11 with '1 remaining'

Note 3

Algorithms written in pseudo code will be represented using the following convention:

Construct	Example usage
Declare subroutines	`Declare CapitalLetterOfName` `End Subroutine`
Call a subroutine	`call SubroutineNeeded`
Declare and use arrays	`myarray[99]`
Literal outputs	`output "Please enter a number"`
Variable names	`myvariable`
Define variable data type	`myvariable is integer`
Data types	`integer, character, string, boolean`
Assignment	`set counter = 0`
Selection	`if . . . else . . . end if`

Indent at least single space after if or do or repeat etc.	`if counter = 1`
	`  output counter`
	`end if`

Annotation	`{Some annotation goes here}`
Comments (for Java only)	`/** Comments for Java */`

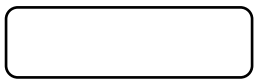
Repetition	`for i . . . next i`
	`repeat . . . until`
	`do . . . loop`
	`do . . . while`
	`while . . . repeat`

Logical operators `AND OR NOT XOR` will be in upper case.
Logical `TRUE` and `FALSE` will be in upper case.

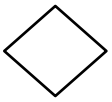
Note 4

Algorithms represented using a flowchart will use the following convention:

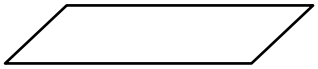
Start / Stop procedure



Decision box

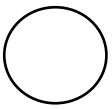


Input / Output

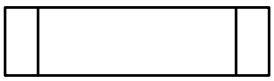


Operation

Connector



Store / Subroutine call



Flow of control
(Arrowhead indicates
direction of flow)