Contents

WJEC GCSE in Computer Science

For Teaching from 2012
For Award from 2014

This is a linear specification: all assessments must be taken at the end of the course.

COMPUTER SCIENCE

SUMMARY OF ASSESSMENT

Unit 1: Understanding Computer Science **45%** **External Assessment: 1½ hours** — **90 Marks (90 UMS)**
This examination will assess understanding of the theory content of the specification with a mixture of short, medium and longer answer questions.
Unit 2: Solving Problems Using Computers **30%** **External Assessment: 2 hours** — **30 Marks (60 UMS)**
This assessment consists of a series of tasks set and marked by WJEC and completed on screen by candidates. These tasks will assess the practical application of knowledge and understanding.
Unit 3: Developing Computing Solutions **25%** **Controlled Assessment: 15 hours** — **50 Marks (50 UMS)**
This controlled assessment will give candidates the opportunity to develop a piece of work using programming software following a task brief from a choice of two issued by WJEC.

AVAILABILITY OF ASSESSMENT AND CERTIFICATION

	Entry Code		June 2014 and each year thereafter
	Subject	Option*	
Unit 1	4341	01 or W1	✓
Unit 2	4342	01 or W1	✓
Unit 3	4343	01 or W1	✓
Subject Award	4340	SA or GU	✓

* Option Codes: English Medium 01, Welsh Medium W1
English Medium SA, Welsh Medium GU – for subject award

Qualification Accreditation Number: 600/6442/0

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COMPUTER SCIENCE

1 INTRODUCTION

1.1 Rationale

The Royal Society report entitled *Shut down or restart?* (January 2012) makes a compelling case for change in the current provision of education in computing in UK schools. It echoes concern expressed in schools, business, industry and universities and highlighted in the report of the Computing at School Working Group, *Computing: A curriculum for schools* (December 2011). There is, therefore, a widely perceived need for a GCSE course in Computer Science that responds to these concerns.

Computing is of enormous importance to the economy, and the role of Computer Science as a discipline itself, as an 'underpinning' subject across science and engineering, is growing rapidly. Young people need to develop skills that will enable them to pursue a career in Computer Science if they so choose, and which will also help them gain valuable skills for life - for example, in innovation, reasoning, logic, resourcefulness, precision, problem solving and clarity. These skills will enable them to become authors of computational tools rather than simply users. As adult workers, young people will be applying for jobs that have not yet been invented. Technology changes but the principles and concepts upon which they are built remain constant. A good grounding in Computer Science will teach young people how to deal with change later in life and play an active and effective role in the digital world.

A course in Computer Science offers candidates a unique opportunity to gain an understanding of how computers work and to create and troubleshoot computer programs for real-life purposes relating to their own personal interests. Computer Science develops valuable programming and computational thinking skills, which are increasingly relevant to a wide variety of jobs. Employers want workers with an understanding of rigorous principles that can be applied to changing technologies.

This GCSE specification encourages candidates to explore how computers work and communicate in a variety of contexts. There is ample opportunity for them to apply and consolidate their knowledge of computer programming by carrying out practical tasks that will develop their capacity for imaginative, innovative thinking, creativity and independence. They will develop the skills of design and evaluation, and they will test and problem-solve when errors occur in both their own systems and those of others.

This GCSE specification encourages candidates from all cultures and both genders to develop their interest in Computer Science by becoming creators of games, apps and systems, rather than simply using programs designed by others.

This WJEC GCSE specification:

- is intended to be of interest to a wide range of candidates including those intending to study Computer Science or ICT at AS or Advanced Level. All units are intended to be accessible to G grade candidates whilst providing some elements that will challenge those working at A*. Some candidates may go on to follow a higher education course or career in Computer Science or an associated area. Those with other interests and aspirations can also benefit from the many transferable skills inherent in the study of Computer Science

- builds upon the knowledge, understanding and skills established whilst studying ICT at Key Stage 3

- develops widely applicable ideas and concepts and a theoretical framework into which these ideas and concepts fit

- promotes progression through the course and provides opportunities for candidates to gain a broad understanding of the skills, understanding and knowledge inherent in the study, design and implementation of computer systems

- encourages candidates to develop their critical thinking skills, to see the relationship between program designer and user, and the role of computational thinking skills within the world in which we live

- provides opportunities to develop candidates' Functional/Essential Skills, particularly those in problem solving, use of IT, application of number and communication. They will also have opportunities to develop their skills in working with others and improving own learning and performance

- is available through the medium of English and Welsh.

1.2 Aims and Learning Outcomes

Following a course in GCSE Computer Science should encourage learners to be inspired, stimulated and excited by following a broad, coherent, satisfying and challenging course of study. It is a rigorous academic discipline incorporating a scientific and mathematical approach which should help learners gain valuable thinking skills that will be attractive to employers and relevant in a vast range of situations and careers.

This specification in Computer Science enables learners to:

- become discerning computer users, able to make informed decisions regarding hardware, software, storage, memory, networks and programming
- acquire and apply creative and technical skills, knowledge and understanding of computers and computer programs in a range of contexts
- understand how computer systems work
- improve their understanding of current technologies and trends towards the future
- develop their understanding of the legal, social, economic, ethical and environmental issues that arise in this digital age
- recognise potential risks when computing, and develop safe and secure systems using professional standards
- communicate effectively both orally and in writing
- be better prepared for further education, training or employment

This specification in Computer Science requires learners to demonstrate knowledge and understanding of:

- how computer systems work, including the functions of their individual components
- methods of storage and their suitability for different tasks
- types of memory and their functions
- the functions of operating systems and utility programs
- how the Internet and other communication networks function
- the relevance of different number systems in computing
- the legal, social, economic, ethical and environmental implications of computer use
- current and emerging technologies

This specification in Computer Science requires learners to demonstrate the ability to:

- think creatively, innovatively, analytically, algorithmically, logically and critically
- show that they can follow a brief to meet requirements
- use computational thinking to design, create and develop their own programming solution to a problem
- use abstraction to model, decompose and generalise
- detect errors in computer programs and correct them
- manipulate data, sequence instructions, test designs and explore ideas
- adopt safe, secure and responsible practice when using computers
- evaluate and improve systems they have created as well as those of others

1.3 Prior Learning and Progression

Although there is no specific requirement for prior learning, this specification builds upon the Programmes of Study for ICT in Key Stages 1-3. This specification may be followed by any candidate, irrespective of their gender, ethnic, religious or cultural background.

This specification is not age specific and, as such, provides opportunities for candidates to extend their life-long learning.

Whilst there is no specific requirement for prior learning in the WJEC AS/Advanced GCE specification in Computing, ICT or Applied ICT there is a clear progression route from this specification.

1.4 Equality and Fair Assessment

GCSEs often require assessment of a broad range of competences. This is because they are general qualifications and, as such, prepare candidates for a wide range of occupations and higher level courses.

The GCSE Computer Science qualification has been reviewed to identify whether any of the competences required by the subject pose a potential barrier to any of the nine protected characteristics covered by the Equality Act 2010. None were identified. Whilst it is acknowledged that some religious/belief groups and people with certain types of medical conditions do not engage with computers, there are no barriers inherent in the qualification that would prevent access to the qualification. Aspects of team work may be difficult for some learners but should not pose a barrier. Team work may be demonstrated through use of supportive and appropriate teaching strategies. Manipulating computers manually is difficult for some disabled learners, but software and new technologies are available to overcome potential barriers and no part of the qualification is likely to require an exemption for disabled learners.

Reasonable adjustments are made for disabled candidates in order to enable them to access the assessments (e.g. candidates are allowed access to a Sign Language Interpreter, using British Sign Language or Irish Sign Language). Information on reasonable adjustments is found in the Joint Council for Qualifications document *Regulations and Guidance: Access Arrangements, Reasonable Adjustments and Special Consideration.* This document is available on the JCQ website (www.jcq.org.uk).

Candidates who are still unable to access a significant part of the assessment, even after exploring all possibilities through reasonable adjustments, may still be able to receive an award. They would be given a grade on the parts of the assessment they have taken and there would be an indication on their certificate that not all of the competences have been addressed. This will be kept under review and may be amended in future.

1.5 Classification Codes

Every specification is assigned a national classification code indicating the subject area to which it belongs. The classification code for this specification is 2610.

Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the School and College Performance Tables.

Centres may wish to advise candidates that, if they take two specifications with the same classification code, schools and colleges are very likely to take the view that they have achieved only one of the two GCSEs. The same view may be taken if candidates take two GCSE specifications that have different classification codes but have significant overlap of content. Candidates who have any doubts about their subject combinations should check with the institution to which they wish to progress before embarking on their programmes.

1.6 Guided Learning Hours

The recommended guided learning hours for GCSE Computer Science are 120 to 140 hours.

2 SPECIFICATION CONTENT

The Learner should be able to:		Amplification of content	
1.	**Computer Systems**		
1.1	Identify and describe computer systems	1.1.1	CPU, input devices, output devices, backing storage, data bus, address bus, ports and connectivity
1.2	Demonstrate an understanding of the Central Processing Unit (CPU)	1.2.1	Components of the CPU: controller, arithmetic/logic unit (ALU), internal memory, registers, buses
		1.2.2	Explain the role of the CPU in fetching and executing instructions stored in memory
1.3	Explain how performance is affected by functions	1.3.1	Size of cache, speed of clock, number of cores, types of processors
1.4	Describe the functions of different types of memory	1.4.1	Random Access Memory (RAM), Read Only Memory (ROM), flash memory, cache memory
1.5	Describe the functional characteristics of secondary storage technologies	1.5.1	Functional characteristics: suitability, capacity, durability, portability, speed
		1.5.2	Technologies such as: optical, magnetic, solid state, storage in the cloud
1.6	Demonstrate an understanding of human-computer interaction		

2. Data Representation

2.1	Identify and explain data representation systems	2.1.1	The nature of data
		2.1.2	Why data needs to be converted into binary format • Binary numbers representing characters • Hexadecimal numbers representing binary numbers • The terms ‘character set’, Unicode and American Standard Code for Information Interchange (ASCII) • Truth tables and logical operations: AND and OR and NOT • Data types such as: integer, real, Boolean, character, string
2.2	Describe the relationship between data storage units	2.2.1	Bit, nybble, byte, kilobyte, megabyte, gigabyte, terabyte, petabyte, exabyte, zettabyte, yottabyte
2.3	Use techniques to convert between number systems	2.3.1	Denary to binary and hexadecimal, binary to denary and hexadecimal, hexadecimal to binary and denary
2.4	Demonstrate how computers interpret instructions	2.4.1	How instructions are coded as bit patterns
		2.4.2	How the computer knows if it is reading instructions or data
		2.4.3	How sound can be sampled and stored digitally
		2.4.4	How an image is represented by pixels in binary format
		2.4.5	Why metadata needs to be included in an image file (including height, width, colour depth)

3. Computer Software

3.1	Identify and explain the functions of an Operating System (OS)	3.1.1	Managing resources and providing user interface
3.2	Describe the functions of commonly used programs	3.2.1	Libraries, software development environment
		3.2.2	Disk organisation such as: file transfer, formatting, compression
		3.2.3	System restore (roll back), disk defragmentation, control panel, system maintenance tools, virus protection, firewall
3.3	Describe common application software	3.3.1	Applications such as: word processing, spreadsheets, presentation, database, drawing

4. Networks

4.1	Define: packets and protocols	4.1.1	IP, TCP, HTTP, FTP, protocol stacks
4.2	Describe network topologies and connections and their advantages and disadvantages	4.2.1	Local Area Network (LAN), Wide Area Network (WAN), common network topologies
		4.2.2	The connections necessary to link a stand-alone computer to a network
4.3	Discuss network security techniques and network policies	4.3.1	Security: user access levels, suitable passwords, encryption techniques
		4.3.2	Network policies for: acceptable use, disaster recovery, backup, archiving

5. Internet & Communications

5.1	Describe how Internet transmissions work	5.1.1	The Internet and the world wide web • Necessary hardware to connect to the Internet • Common file standards associated with the Internet, e.g. HTML, JPEG • Compression and compression types (including lossy and lossless) for files to be transmitted via the Internet • Encryption, data compression, data redundancy (for error detection and correction) and security • Packet switching • Routing • MAC addresses • IP addresses
5.2	Describe and explain Internet communication protocols	5.2.1	How Domain Name System (DNS) servers and Internet Protocol (IP) addresses work
		5.2.2	Advantages for the Internet Service Provider (ISP) and the user
		5.2.3	Why HTML is important as a standard for web page creation
		5.2.4	The role of cookies
		5.2.5	How search engines work
5.3	Use and demonstrate an understanding of HTML	5.3.1	Use HTML to create a web page
		5.3.2	Use HTML tags: <html>, < body>, <h1>, <p>, <b>, <i>, <u>, <big>, <small>, , <img>, <a href=”url”>, and their closures

6. Algorithms

6.1	Demonstrate an understanding of algorithms	6.1.1	Interpret and dry run simple algorithms
		6.1.2	Choice may be influenced by data structure and data values
		6.1.3	The need for accuracy in both algorithm and data
6.2	Use algorithms	6.2.1	Write algorithms in pseudocode or flow diagrams to solve problems
		6.2.2	Complete algorithms
		6.2.3	Test and correct algorithms

7. Programming

7.1	Define and describe programming tools and terms	7.1.1	Tools: high level languages, machine code, variables, constants, data types
		7.1.2	Variables such as: static, dynamic, global, local
		7.1.3	Data types such as: number, integer, character, string, Boolean
7.2	Describe and explain translators	7.2.1	Why translators, compilers, interpreters, and assemblers are needed
		7.2.2	The types of error that may occur in programming code such as: syntax, run time/execution, logical, linking, rounding, truncation
7.3	Describe and explain programming errors	7.3.1	Strategies to avoid errors which may occur in programming code

7.4	Describe and use programming constructs	7.4.1 one-dimensional arrays pseudocode algorithms logical expressions appropriate data types variables and constants
7.5	Demonstrate an understanding of and use programming	7.5.1 Programming languages such as: • Small domain-specific languages • Visual languages • Text-based languages • HTML to edit / create web pages
		7.5.2 Design and write solutions to given problems such as: write an app, a game or a tool to perform a task
		7.5.3 Debug programs
		7.5.4 Explain how a program achieves its intended result

8 Practical Investigation

8.1	Plan a practical investigation and develop and implement a solution to a given brief	8.1.1	Use suitable techniques, practically and logically breaking the problem down using abstraction and decomposition
		8.1.2	Re-use existing software, e.g. from a library
8.2	Test the solution	8.2.1	Explain the need to choose suitable test data and assess its adequacy
		8.2.2	Use test data and state the outcome of the tests
8.3	Modify the solution according to test results	8.3.1	Use strategies for detecting and overcoming problems caused by mistakes in the original program
8.4	Produce a report of the investigation	8.4.1	The report should use appropriate specialist terms correctly and be presented clearly with headings and should include user documentation and a user guide
8.5	Evaluate your solution	8.5.1	Evaluate the final solution and make conclusions based on the evidence presented in the report

9. Ethical, Social, and Legal Aspects

9.1	Explain the importance of conforming to professional standards	9.1.1	The individual's own personal code, any informal code of ethical behaviour that exists in the work place, exposure to formal codes of ethics
		9.1.2	Legislation relevant to computing
9.2	Use computer systems responsibly and effectively	9.2.1	Respect the integrity of the systems used, including not divulging passwords or private keys to anyone else
		9.2.2	Recognise that certain data is confidential and that the intended use of all data must be respected
		9.2.3	Users should become familiar with and abide by the guidelines for appropriate usage of the systems and networks that they access

3 SCHEME OF ASSESSMENT

3.1 Assessment Scheme

Assessment for GCSE Computer Science is untiered, i.e. all units cater for the full range of ability and allow access to grades A*-G.

The specification uses a range of assessment techniques to enable the candidate to respond graphically and in writing through practical and investigative work. Forty-five per cent of the assessment is through an externally set and marked written examination testing the full ability range, requiring a mixture of short answer, single sentence and extended responses. Twenty-five per cent of the marks are based on an internally-assessed controlled assignment which allows the candidates to experience appropriate roles relevant to Computer Science as designer and maker of computer-based systems. The remaining thirty per cent of the final assessment consists of a series of tasks set and marked by WJEC which the candidate completes using a computer.

The scheme of assessment is outlined below.

Unit 1 Understanding Computer Science	**Written examination**
Duration 1½ hours **90 marks**	**45%**
WJEC will set an examination each session covering the following aspects of the specification content: • Computer Systems • Data Representation • Computer Software • Networks • Internet & Communications • Algorithms • Programming • Ethical, Social, and Legal Aspects This external assessment will take the form of a paper-based examination. However, in future years, it may be available in electronic format as an on-screen assessment.	

Unit 2 Solving Problems Using Computers		**Externally Marked Practical Assessment**
Duration 2 hours	**30 marks**	**30%**

This assessment consists of a series of tasks set and marked by WJEC and completed on-screen by the candidate. These tasks will assess the practical application of programming knowledge.

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

Some of these tasks will require work to be completed using Greenfoot, a package which is freely available for legal download (http://www.greenfoot.org/door). The interface is available in both English and Welsh.

WJEC will supply a paper copy of the assessment tasks and a file/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 pre-installed
- File(s) supplied by WJEC pre-installed for use in the assessment.

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.

At the end of the assessment candidate work must be copied to a secondary storage medium and sent for marking to an address supplied by WJEC. The centre must also keep an electronic copy of the candidate work in a secure location in case of loss or damage to the original submission.

Unit 3: Developing Computing Solutions **15 hours**	**50 marks**	**Controlled Assessment** **25%**
This controlled assessment will give candidates the opportunity to develop a piece of work using programming software following a task brief from a choice of two issued by WJEC.		
Design of solution	8 marks	
Implementation	17 marks	
Program documentation	5 marks	
Testing	8 marks	
Evaluation	12 marks	

The tasks will be set so that they can be completed using any of a range of text-based languages such as C, C++, Greenfoot, Java, Pascal, PHP, Python, Visual Basic, etc.

Candidates will be expected to produce a word-processed report of about 2,000 words.

The report should:

- describe the design, implementation and testing of their solution e.g.
    - sequencing
    - choice (if - then - else)
    - iteration (loops)
    - language constructs that support abstraction (typically a 'procedure' or 'function' with parameters)
    - some form of interaction with the program's environment (input/output or event-based)
- find and correct errors in their code
- reflect thoughtfully on their program, including assessing its correctness and fitness for purpose; understanding its efficiency; and describing the system to others.

The report should be written so that it will be intelligible to someone who is familiar with the content of the specification but has not observed the work being carried out.

This work may be submitted on paper or electronically.

A generic mark scheme for the controlled assessment unit follows overleaf.

Unit 3 - Controlled Assessment - Mark Scheme

Quality of Written Communication

The quality of written communication is assessed as an integral part of the candidate evaluation and not as a standalone element, using the following specific criteria:

- legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning
- selection of a form and style of writing appropriate to purpose and to complexity of subject matter
- organisation of information clearly and coherently, use of specialist vocabulary where appropriate

Mark Grid

Design of Solution	**Max 8 marks**
7 - 8 marks	The candidate has provided a detailed analysis of the task and a comprehensive description fully justifying their intended solution in terms of the programming facilities of the language software chosen. The pseudocode (or flow chart) is well annotated, showing a thorough understanding. The candidate has produced a complete suite of algorithms covering the whole solution as well as any validation required. There is a comprehensive testing strategy and evaluation criteria that will allow the performance of the completed system to be measured. The design demonstrates a clear sense of audience and purpose.
4 - 6 marks	The candidate has provided a brief analysis of the task and a basic description identifying a sufficient number of processes to provide a working solution to the given task. The pseudocode (or flow chart) is annotated, showing some understanding. The candidate has produced basic algorithms covering most of their solution and some evidence of discussion of any validation required. The candidate has devised a strategy allowing them to test most of the functionality and evaluate their completed solution. The design demonstrates some sense of audience and purpose.
1 – 3 marks	The candidate has produced a minimal solution and has briefly described some tasks but the outline of the solution is not specific for all parts of the solution. There is some evidence of use of pseudocode (or flow chart) although annotation may be absent. Some basic algorithms may be evident for part of the solution. The candidate has made brief comments on how the solution may be tested but has not referred to success criteria and the solution may be incomplete.
0 marks	No valid response.

Implementation	**Max 17 marks**
14 - 17 marks	The candidate has produced a fully functioning solution to the given task. They have fully exploited, as appropriate, the facilities of the chosen programming language and have demonstrated a sound understanding of the appropriate techniques available to them.
9 - 13 marks	The candidate has produced a functional solution to the given task. They have used, as appropriate, the facilities of the chosen programming language and have demonstrated an understanding of the tools and techniques used.
5 - 8 marks	The candidate has produced a solution to the given task that provides the majority of the required functionality. The candidate has used a range of the facilities of the programming language and has demonstrated some understanding of the tools and techniques used.
1 - 4 marks	The candidate has produced a partial solution to the given task. They have made some use of the facilities of the programming language, demonstrating a limited understanding of the tools and techniques used.
0 marks	No valid response.

Program Documentation	**Max 5 marks**
5 marks	The candidate has fully documented a solution and used appropriate self-documenting identifiers. Listings of each programming routine are appropriately laid out and contain sufficient annotation to demonstrate a sound understanding of the programming code used. The user interface is fit for audience and purpose.
3 - 4 marks	The candidate has documented a solution with listings of all major programming routines with some evidence of use of self-documenting code and annotation, demonstrating some understanding of the programming code used. The user interface is fit for audience and purpose.
1 - 2 marks	The candidate has produced some listings of the programming routines used but there is little evidence of self-documenting code or annotation.
0 marks	No valid response.
Testing	**Max 8 marks**
6 - 8 marks	The test plan covers all the success criteria and the candidate has included extensive evidence of thorough testing of the completed solution with an informed commentary of the testing process.
3 - 5 marks	The test plan covers most of the success criteria and the candidate has included evidence of thorough testing of the completed solution and included commentaries describing the testing process.
1 - 2 marks	The candidate has included brief evidence of some testing but the solution may be incomplete.
0 marks	No valid response.
Evaluation (including quality of written communication)	**Max 12 marks**
10 - 12 marks	The candidate has produced an informed discussion of the performance of the completed solution against the evaluation criteria. The candidate is able to make valid and detailed suggestions for further improvements. The text is legible, information is organised clearly and coherently with correct use of specialist vocabulary where appropriate and meaning is clear. Spelling, punctuation and grammar are accurate. The form and style of writing is appropriate to purpose and to the complexity of the subject matter.
7 - 9 marks	The candidate has produced a discussion of the performance of the solution against the evaluation criteria and has made some valid suggestions for further improvements to the solution. The text is legible, information is organised clearly with correct use of specialist vocabulary where appropriate and meaning is clear. Spelling, punctuation and grammar are accurate. The form and style of writing is appropriate to purpose and the subject matter.
4 - 6 marks	There is some discussion of the performance of the solution measured against the evaluation criteria. The candidate is able to make some suggestions for further improvements to the solution. The text is legible and specialist vocabulary, where used, is appropriate. There may be errors in spelling, punctuation and grammar.
1 - 3 marks	The evaluation is superficial. Comments lack clarity and are expressed in everyday language. Suggestions for improvements are limited or absent. There are significant errors in spelling, punctuation and grammar.
0 marks	No valid response
	Total 50 marks

3.2 Assessment Objectives

Candidates will be required to demonstrate their ability to:

AO1 Recall, select and communicate knowledge and understanding of computer technology.

AO2 Apply knowledge, understanding and skills to solve computing or programming problems.

AO3 Analyse, evaluate, make reasoned judgements and present conclusions.

The weighting of assessment objectives across assessment components is as follows:

Single Award	AO1	AO2	AO3	Total
Unit 1 Written Examination	**27**	**9**	**9**	**45**
Unit 2 Practical Examination	**6**	**19**	**5**	**30**
Unit 3 Controlled Assessment	**2**	**12**	**11**	**25**
Total Weighting	**35%**	**40%**	**25%**	**100%**

3.3 Quality of Written Communication

Computer Science candidates will be assessed on the quality of their written communication within the overall assessment of that component in accordance with *Regulations for the Assessment of the Quality of Written Communication*.

Mark schemes for these components include the following specific criteria for the assessment of written communication where extended written answers are expected:

- legibility of text, accuracy of spelling, punctuation and grammar, clarity of meaning
- selection of a form and style of writing appropriate to purpose and to complexity of subject matter
- organisation of information clearly and coherently, use of specialist vocabulary where appropriate.

4 AWARDING, REPORTING AND RE-SITTING

GCSE qualifications are reported on an eight point scale from A* to G, where A* is the highest grade. The attainment of pupils who do not succeed in reaching the lowest possible standard to achieve a grade is recorded as U (unclassified) and they do not receive a certificate.

This is a linear specification in which all assessments must be taken at the end of the course. Where candidates wish to re-sit, external components must be re-taken. The controlled assessment component may also be re-taken according to the guidelines given in 'Administration of Controlled Assessment'. Alternatively, the UMS mark for the component may be carried forward for aggregation with the external components when these are re-taken.

Individual unit results are reported on a uniform mark scale (UMS) with the following grade equivalences:

GRADE	Unit Weighting	MAX	A*	A	B	C	D	E	F	G
Unit 1	45%	90	81	72	63	54	45	36	27	18
Unit 2	30%	60	54	48	42	36	30	24	18	12
Unit 3	25%	50	45	40	35	30	25	20	15	10

SUBJECT AWARD UMS

GCSE	MAX	A*	A	B	C	D	E	F	G
Subject Award	200	180	160	140	120	100	80	60	40

This specification is not available to private candidates.

5 GRADE DESCRIPTIONS

Grade descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The descriptions must be interpreted in relation to the content specified by the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of the specification may be balanced by better performance in others.

Grade F

Candidates recall, select and communicate a basic knowledge and understanding of computer hardware, software and other related technologies. They identify, with guidance, the information relevant to solve a problem from the context. They apply limited knowledge, understanding and skills to design and implement basic computer programs which solve these problems. In their solutions they use simple models, collect some necessary data, use simple instructions to process the data and present the results. They sometimes review their work and provide comments on how they and others use computer technology to solve problems and make simple modifications to improve their work. Candidates demonstrate some awareness of the need for safe, secure and responsible practices. They use ICT to communicate, demonstrating limited awareness of purpose and audience.

Grade C

Candidates recall, select and communicate a good knowledge and understanding of the function, application, merits and implications of a range of computer hardware, software and other related technologies. They analyse problems, identifying and collecting some information relevant to solve them from the context of the problem. They apply knowledge, understanding and skills to design and implement computer programs which solve these problems. In their solutions, they model situations, acquire input data, sequence instructions, manipulate and process data and present the results of the processing in a mostly appropriate format. They review their work and evaluate the way they and others use computer technology to solve problems and make improvements to their work where appropriate. Candidates work using safe, secure and responsible practices. They use ICT to communicate, demonstrating consideration of purpose and audience.

Grade A

Candidates recall, select and communicate a thorough knowledge and understanding of the function, application, merits and implications of a broad range of computer hardware, software and other related technologies. They systematically analyse problems, identifying and collecting the information required to solve them from the context of the problem. They apply knowledge, understanding and skills to design and implement effective computer programs which solve these problems. In their solutions, they effectively model situations, acquire and validate input data, sequence instructions, manipulate and process data and present the results of the processing in an appropriate format. They work systematically and critically evaluate the way they and others use computer technology to solve problems. They iteratively review their work and make improvements where appropriate. Candidates work systematically and understand and adopt safe, secure and responsible practices. They use ICT to communicate effectively, demonstrating a clear sense of purpose and audience.

6 ADMINISTRATION OF CONTROLLED ASSESSMENT

Regulations for controlled assessment are defined for the three stages of the assessment:

- task setting
- task taking
- task marking

For each stage the regulatory authorities have specified a certain level of control to ensure authenticity and reliability.

The controlled assessment is untiered and differentiation is by outcome.

Task setting – high control

The controlled assessment component may contain more than one task. Tasks will be provided by WJEC. The tasks will allow opportunities for contextualisation to best suit centre-specific circumstances.

A choice of controlled assignments will be released in July each year. The first assignments will be valid for submission in May 2014. Assignments released in July 2013 will be valid for assessment in May 2015, and so on.

Task taking – medium control

Authenticity control

Candidates must complete all work, with the exception of research, under informal supervision in the classroom. Although the teacher will not see every keystroke of every candidate, sufficient work must be seen by the teacher to verify it as the candidates' own. Research may be completed under limited supervision.

Centres are responsible for providing sufficient supervision to be able to give an assurance that the assessments submitted are based on the work of the candidates concerned.

The teacher responsible for the supervision of the candidates' work will be required to certify that the marks submitted were awarded in accordance with the assessment criteria and that she/he is satisfied that the work submitted is that of the candidate concerned.

Feedback control

Candidates are expected to work on their controlled tasks independently of their teacher although they can receive formative feedback. It is not permitted for candidates to draft work and re-submit it after it has been assessed by the teacher. There will, of course, be occasions when direct teacher intervention and support is necessary. In such cases, the details should be recorded on the assessment sheets and marks awarded must reflect the level of support given.

Time control and word limit

All controlled assessments must be carried out under time controlled conditions. The duration of the assessment is fifteen hours. It is advisable that centres record the date and time of the assessments, the name of the supervisor(s), i.e. the subject teacher, and a log of any incidents which occurred during the course of the assessments. The report should be about 2,000 words.

Collaboration control

Candidates may collaborate in carrying out research activities and the work of the individual may be informed by discussions with others, but candidates must provide an individual response.

Resources

It is accepted that certain parts of a candidate's work may be taken from other sources where these are relevant and appropriate. This is perfectly acceptable as long as all such cases are clearly identified in the text and fully acknowledged. Where phrases, sentences or sequences of code are quoted directly from a source, it is important that candidates use quotation marks or acknowledge ideas are taken from the work of others.

Task marking – medium control

Teachers mark the controlled assessments using mark schemes and guidance provided by WJEC. The teacher will mark the work and ensure that there is sufficient annotation and documentation to enable the moderator to assess it accurately.

Centres following this specification must apply a consistent standard of marking across different teachers and teaching groups. Where more than one teacher is involved in assessment, centres are responsible for standardising assessments in order to ensure a single rank order of candidates for the centre as a whole.

It is necessary to provide some method of moderating internal assessments of candidates' work to ensure that no injustice occurs to candidates as a result of variation in the standards applied by different centres. WJEC will moderate the internal assessment.

Work will be submitted for moderation in May of the year of the examination. Where fewer than eleven candidates are entered, all outcomes will be reviewed. Where more than this number is involved a sample will be moderated in the first instance.

Adjustments to the assessments submitted by a centre will normally ensure that the rank order is unaltered, and will be made to bring centre's assessments into line with the national standard. WJEC reserves the right to request that all submissions are seen if the exercise reveals problems which cannot be resolved by normal moderation procedures.

WJEC moderation will be consistent with the requirements of the Code of Practice for GCSE.

Submission of Controlled Assessments

Candidate work for the controlled assessment should be submitted to WJEC electronically. The submission should include a functioning copy of the solution and supporting documents in portable document format (pdf).

Further details will be issued by WJEC along with the controlled assignments each year.

Authentication of Controlled Assessments

Candidates are required to sign that the work submitted is their own and teachers/assessors are required to confirm that the work assessed is solely that of the candidate concerned and was conducted under the required conditions. A copy of the authentication form, which forms part of the 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 the moderator. 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 controlled assessment 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 Controlled Assessment.* More detailed guidance on the prevention of plagiarism is given in *Plagiarism in Examinations,* also available on the JCQ website.

7 THE WIDER CURRICULUM

Essential Skills (Wales) and Functional Skills

GCSE Computer Science will provide a range of opportunities for developing these skills, whether in preparation for functional skills assessments or to provide contexts in which evidence for essential skills (Wales) portfolios may be produced. The following essential skills can be developed through this specification at levels 1 and 2:

- Communication
- Application of Number
- Information and Communication Technology
- Problem Solving
- Working with Others
- Improving Own Learning and Performance

Mapping of opportunities for the development of these skills against essential skills evidence requirements is provided in *Exemplification of Essential Skills for Computer Science*, available on the WJEC website.

Opportunities for use of technology

The nature of Computer Science and the practical tasks and controlled assignment used for assessment provide opportunities for the use of a wide range of technologies.

Computer Science also provides opportunities to promote enterprise and entrepreneurial skills through the process of identifying an opportunity to design a system to meet a specific need, developing their own system and finally evaluating the whole process. Tasks linked to the controlled assignment provide opportunities to develop independent thinking skills, through candidates identifying relevant sources of information and developing specific performance criteria for their designs to guide their thinking.

Spiritual, Moral, Ethical, Social and Cultural Issues

This specification provides opportunities for candidates, through the study of computer systems and applications, to develop an understanding of spiritual, moral, ethical, social and cultural issues as they relate to computer users.

The specification requires that candidates should use computer systems responsibly, respect the integrity of the systems they use and the privacy of other users. They should conform to professional standards of ethical behaviour.

Candidates are required to know and understand the provisions of legislation relevant to computer users. They should recognise that certain data is confidential and that the intended use should be respected.

Candidates are asked to consider data security when using computer systems for storing, processing and transmission of data. Consideration is also given to how to protect data from deliberate damage caused by viruses and other types of malicious damage and how to protect stored or transmitted data from unauthorised access.

Citizenship

In this context citizenship is taken to include the development of social and moral responsibility, participation in community activity and development of political literacy. This specification is designed to make a contribution to the development of the knowledge, skills and understanding of citizenship. Aspects of the controlled assignments, for example, could be directly related to the needs of the school or local community, which would provide candidates with the opportunity to tackle problems which are real and meaningful to themselves. They would also need to consider critically and constructively the views of others when developing and evaluating proposed solutions.

The specification content requires candidates to consider the consequences of the use of computer technology. For example, candidates should be able to suggest potential health hazards when using computers and be able to suggest methods for prevention or reducing the risk of potential health hazards. A number of issues including attitudes to hacking, the spreading of viruses, computer fraud, copyright and identity theft are also considered.

Environmental Issues

Candidates will need to be aware of the effect that the use of computers has on the environment. Opportunities to consider environmental issues will occur in this specification.

Health and Safety Consideration

Candidates would be expected to consider health and safety issues when designing their own systems, particularly within the context of the controlled assignment.

The European Dimension

This specification is consistent with current EC agreements.

The approach used in constructing the specification lends itself to the establishment of links with other areas of study, particularly those involving problem solving or the use of computational thinking skills, knowledge and understanding for the completion of tasks and assignments in other GCSE specifications.

The above approach conforms with the aspirations expressed in the 1998 Resolutions of the European Community and the Ministers of Education meeting within the Council, concerning the European dimension in education and environmental education, particularly those intended at the level of member states.