

SYLLABUS

Cambridge IGCSE[®]
Computer Science (US)
0473

For examination in June and November 2015

This syllabus is available only to Centers taking part in the
Board Examination Systems (BES) Pilot.

If you have any questions about this syllabus, please contact Cambridge at
info@cie.org.uk quoting syllabus code 0473.

Changes to Syllabus for 2015

- Change of syllabus name:
Previously named “0441 Computer Studies,” this syllabus has been reviewed throughout to bring it up to date and to allow learners to begin the development of their computational thinking and programming skills. Teachers are advised to read the whole syllabus document before planning their teaching programs. As “Computer Science,” this syllabus now shares the same name as the AS/AL syllabus (formerly AS/AL Computing), indicating the firm links and progression between these syllabi.
- New syllabus code: 0473
- Some changes to the assessment structure, but with many features retained (see Section 4):
 - All components are externally assessed.
 - Paper 1 Theory is now 1 hour, 45 minutes; 60% weighting; 75 marks.
 - New Paper 2 Problem-solving and Programming: 1 hour, 45 minutes; 40% weighting; 50 marks. This paper replaces Paper 2 Coursework and Paper 3 Alternative to Coursework. There are pre-release materials for Paper 2 Problem-solving and Programming for students to complete practical tasks. Teachers are expected to incorporate the pre-release material tasks into their lessons and give support in finding methods and reaching solutions.
- There is no coursework.
- Clarified syllabus goals and assessment objectives (see Section 5).
- Revised syllabus content (see Section 6):
 - One new practical topic—introducing candidates to the concept of arrays and so enabling students to develop programming solutions for real-world problems.
 - Two new theory topics: computer ethics and hexadecimal numbers.
 - One topic removed: systems life cycle.

Note

The subject content of this syllabus is the same as the international version. The alternative to practical paper is not included to ensure that coursework or the practical paper is a mandatory part of the syllabus.

Please read the *Cambridge Glossary* alongside this syllabus. This is available from our website. Administration materials appear in UK English and are standard for all our international customers.

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Contents

1. Introduction	2
1.1 Why Choose Cambridge?	
1.2 Why Choose Cambridge IGCSE?	
1.3 Why Choose Cambridge IGCSE Computer Science?	
1.4 Cambridge ICE (International Certificate of Education)	
1.5 How Can I Find Out More?	
2. Teacher Support	5
2.1 Support Materials	
2.2 Resource Lists	
2.3 Training	
3. Curriculum Content at a Glance	6
4. Assessment at a Glance	7
5. Syllabus Goals and Assessment Objectives	8
5.1 Syllabus Goals	
5.2 Assessment Objectives	
5.3 Relationship Between Assessment Objectives and Components	
5.4 Grade Descriptions	
6. Curriculum Content	10
7. Description of Components	17
7.1 Scheme of Assessment	
7.2 Paper 2 Problem-solving and Programming Pre-release Materials	
8. Notes for the Guidance of Teachers	18
9. Other Information	19

1. Introduction

1.1 Why Choose Cambridge?

Recognition

Cambridge International Examinations is the world's largest provider of international education programs and qualifications for students aged 5 to 19. We are part of Cambridge Assessment, a department of the University of Cambridge, trusted for excellence in education. Our qualifications are recognized by the world's universities and employers.

Cambridge IGCSE® (International General Certificate of Secondary Education) is internationally recognized by schools, universities, and employers as equivalent in demand to UK GCSEs. Learn more at www.cie.org.uk/recognition

Excellence in Education

Our mission is to deliver world-class international education through the provision of high-quality curricula, assessment, and services.

More than 9,000 schools are part of our Cambridge learning community. We support teachers in over 160 countries who offer their students an international education based on our curricula and leading to our qualifications. Every year, thousands of students use Cambridge qualifications to gain admission to universities around the world.

Our syllabi are reviewed and updated regularly so that they reflect the latest thinking of international experts and practitioners and take into account the different national contexts in which they are taught.

Cambridge programs and qualifications are designed to support students in becoming:

- **confident** in working with information and ideas—their own and those of others
- **responsible** for themselves, responsive to and respectful of others
- **reflective** as students, developing their ability to learn
- **innovative** and equipped for new and future challenges
- **engaged** intellectually and socially, ready to make a difference.

Support for Teachers

A wide range of materials and resources is available to support teachers and students in Cambridge schools. Resources suit a variety of teaching methods in different international contexts. Through subject discussion forums and training, teachers can access the expert advice they need for teaching our qualifications. More details can be found in Section 2 of this syllabus and at www.cie.org.uk/teachers

Support for Exams Officers

Exams officers can trust in reliable, efficient administration of exam entries and excellent personal support from our customer services. Learn more at www.cie.org.uk/examsOfficers

Nonprofit, Part of the University of Cambridge

We are a nonprofit organization where the needs of the teachers and students are at the core of what we do. We continually invest in educational research and respond to feedback from our customers in order to improve our qualifications, products, and services.

Our systems for managing the provision of international qualifications and education programs for students aged 5 to 19 are certified as meeting the internationally recognized standard for quality management, ISO 9001:2008. Learn more at www.cie.org.uk/ISO9001

1.2 Why Choose Cambridge IGCSE?

Cambridge IGCSEs are international in outlook but retain a local relevance. The syllabi provide opportunities for contextualized learning, and the content has been created to suit a wide variety of schools, avoid cultural bias, and develop essential lifelong skills, including creative thinking and problem solving.

Our goal is to balance knowledge, understanding, and skills in our programs and qualifications to enable candidates to become effective students and to provide a solid foundation for their continuing educational journey.

Through our professional development courses and our support materials for Cambridge IGCSEs, we provide the tools to enable teachers to prepare students to the best of their ability and work with us in the pursuit of excellence in education.

Cambridge IGCSEs are considered to be an excellent preparation for Cambridge International AS and A Levels, the Cambridge AICE (Advanced International Certificate of Education) group award, Cambridge Pre-U, and other education programs, such as the US Advanced Placement program and the International Baccalaureate Diploma program. Learn more about Cambridge IGCSEs at www.cie.org.uk/cambridgesecondary2

Guided Learning Hours

Cambridge IGCSE syllabi are designed with the assumption that candidates have about 130 guided learning hours per subject over the duration of the course, but this is for guidance only. The number of hours required to gain the qualification may vary according to local curricular practice and the candidates' prior experience of the subject.

1.3 Why Choose Cambridge IGCSE Computer Science?

The Cambridge IGCSE Computer Science syllabus enables students to develop an interest in computing and gain confidence in computational thinking and programming. Cambridge IGCSE Computer Science is an ideal foundation for further study at Cambridge International A Level, and the skills learned can also be used in other areas of study and in everyday life.

Prerequisites

Students beginning this course are not expected to have studied computer science or IT previously.

Progression

Cambridge IGCSE Certificates are general qualifications that enable candidates either to progress directly to employment or to proceed to further qualifications.

Candidates who are awarded grades C to A* in Cambridge IGCSE Computer Science are well prepared to follow courses leading to Cambridge International AS and A Level Computer Science, or the equivalent.

1.4 Cambridge ICE (International Certificate of Education)

Cambridge ICE is a group award for Cambridge IGCSE. It gives schools the opportunity to benefit from offering a broad and balanced curriculum by recognizing the achievements of candidates who pass examinations in at least seven subjects. To qualify for the Cambridge ICE award candidates are required to have studied subjects from five groups: two languages from Group I and one subject from each of the remaining four groups. The seventh subject can be taken from any of the five subject groups.

Computer Science (0473) is in Group V, Creative, Technical, and Vocational Subjects.

Learn more about Cambridge ICE at www.cie.org.uk/cambridgesecondary2

The Cambridge ICE is awarded from examinations administered in the June and November series each year.

Detailed timetables are available from www.cie.org.uk/examsOfficers

1.5 How Can I Find Out More?

If You Are Already a Cambridge School

You can make entries for this qualification through your usual channels. If you have any questions, please contact us at info@cie.org.uk

If You Are Not Yet a Cambridge School

Learn about the benefits of becoming a Cambridge school at www.cie.org.uk/startcambridge. Email us at info@cie.org.uk to find out how your organization can register to become a Cambridge school.

2. Teacher Support

2.1 Support Materials

Cambridge syllabi, past question papers, and examiner reports to cover the last examination series are on the *Syllabus and Support Materials* DVD, which we send to all Cambridge schools.

You can also go to our public website at www.cie.org.uk/igcse to download current and future syllabi together with specimen papers or past question papers and examiner reports from one series.

For teachers at registered Cambridge schools a range of additional support materials for specific syllabi is available online. For Teacher Support go to <http://teachers.cie.org.uk> (username and password required).

2.2 Resource Lists

We work with publishers providing a range of resources for our syllabi including textbooks, websites, CDs, etc. Any endorsed, recommended, and suggested resources are listed on both our public website and on Teacher Support.

The resource lists can be filtered to show all resources or just those that are endorsed or recommended by Cambridge. Resources endorsed by Cambridge go through a detailed quality assurance process and are written to align closely with the Cambridge syllabus they support.

2.3 Training

We offer a range of support activities for teachers to ensure they have the relevant knowledge and skills to deliver our qualifications. See www.cie.org.uk/events for further information.

3. Curriculum Content at a Glance

All candidates study the following topics.

Sections	Topics
Section 1 Theory of Computer Science	1.1 Data representation <ul style="list-style-type: none"> 1.1.1 Binary systems 1.1.2 Hexadecimal 1.1.3 Data storage 1.2 Communication and Internet technologies <ul style="list-style-type: none"> 1.2.1 Serial and parallel data transmission 1.2.2 Security aspects 1.2.3 Internet principles of operation 1.3 Hardware and software <ul style="list-style-type: none"> 1.3.1 Logic gates 1.3.2 Computer architecture and the fetch-execute cycle 1.3.3 Input devices 1.3.4 Output devices 1.3.5 Memory, storage devices, and media 1.3.6 Operating systems 1.3.7 High- and low-level languages and their translators 1.4 Security 1.5 Ethics
Section 2 Practical Problem-solving and Programming	2.1 Algorithm design and problem-solving <ul style="list-style-type: none"> 2.1.1 Problem-solving and design 2.1.2 Pseudocode 2.2 Programming <ul style="list-style-type: none"> 2.2.1 Programming concepts 2.2.2 Data structures; arrays 2.3 Databases

4. Assessment at a Glance

For Cambridge IGCSE Computer Science, candidates take two components: Paper 1 and Paper 2.

Components		Weighting
<p>Paper 1: Theory</p> <p>This written paper contains short-answer and structured questions. There is no choice of questions.</p> <p>No calculators are permitted in this paper.</p> <p>75 marks</p> <p>Externally assessed</p>	1 hour, 45 minutes	60%
<p>Paper 2: Problem-solving and Programming</p> <p>This written paper contains short-answer and structured questions. There is no choice of questions. 20 of the marks for this paper are from questions set on the pre-release material.¹</p> <p>No calculators are permitted in this paper.</p> <p>50 marks</p> <p>Externally assessed</p>	1 hour, 45 minutes	40%

Availability

This syllabus is examined in the June and November examination series.

Detailed timetables are available from www.cie.org.uk/examsOfficers

Combining This with Other Syllabi

Candidates can combine this syllabus in an examination series with any other Cambridge syllabus, except:

- syllabi with the same title at the same level

Please note that Cambridge IGCSE and Cambridge International Level 1/Level 2 Certificate are at the same level.

¹ The pre-release material will be made available to Centers six months before the examination. It will also be reproduced in the question paper. Candidates are not permitted to bring any prepared material into the examination.

5. Syllabus Goals and Assessment Objectives

5.1 Syllabus Goals

The Cambridge IGCSE Computer Science syllabus goals are to:

- develop computational thinking
- develop an understanding of the main principles of solving problems by using computers
- develop understanding that every computer system is made up of subsystems, which in turn consist of further subsystems
- develop an understanding of the component parts of computer systems and how they interrelate, including software, data, hardware, communications, and people
- acquire the skills necessary to apply this understanding to develop computer-based solutions to problems using a high-level programming language.

Computer science is the study of the foundational principles and practices of computation and computational thinking and their application in the design and development of computer systems.

This syllabus aims to encourage candidates to develop computational thinking, that is, thinking about what can be computed and how, and includes consideration of the data required. Learning computational thinking involves learning to program, that is, to write computer code because this is the means by which computational thinking is expressed.

The assessment is by written papers, but the learning should be done in a mainly practical way: problem-solving and programming. Questions will require the candidate to think, use knowledge with understanding, and demonstrate understanding gained through practicing practical skills. Questions will not revolve around pure recall.

5.2 Assessment Objectives

- AO1** Recall, select, and communicate knowledge and understanding of computer technology.
AO2 Apply knowledge, understanding, and skills to solve computing or programming problems.
AO3 Analyze, evaluate, make reasoned judgments, and present conclusions.

5.3 Relationship Between Assessment Objectives and Components

The **approximate** weightings allocated to each of the assessment objectives are summarized below.

Assessment objective	Paper 1	Paper 2	Weighting for qualification
AO1	32%	8%	40%
AO2	16%	24%	40%
AO3	12%	8%	20%
Total	60%	40%	100%

5.4 Grade Descriptions

Grade A

- Candidates communicate a thorough knowledge and understanding of the characteristics and methods of operation of a broad range of computer hardware, software, and communications.
- They systematically analyze problems and identify efficient methods to solve them. They apply knowledge, understanding and skills to design and write effective computer programs that solve these problems. In their solutions, they effectively validate input data; sequence instructions; manipulate, store, and process data and represent the results of the processing in an appropriate format. They plan thorough systematic testing of programmed solutions. They amend their own programs as well as those written by others when requirements change.
- Candidates work systematically and critically evaluate the way they and others produce and use computer solutions.
- They understand and adopt safe, secure, and responsible practices.

Grade C

- Candidates communicate a good knowledge and understanding of the characteristics and methods of operation of a broad range of computer hardware, software, and communications.
- They analyze problems and identify methods to solve them. They apply knowledge, understanding, and skills to design and write computer programs that solve these problems. In their solutions, they select input data; sequence instructions; manipulate, store, and process data; and represent the results of the processing in a mostly appropriate format. They plan testing of programmed solutions. They amend programs when requirements change.
- They evaluate the way they and others produce and use computer solutions.
- Candidates work using safe, secure, and responsible practices.

Grade F

- Candidates communicate a basic knowledge and understanding of the characteristics and methods of operation of a limited range of computer hardware, software, and communications.
- They apply limited knowledge, understanding, and skills to design and write basic computer programs that solve simple problems. In their solutions, they input some data, use simple instructions to process data, and represent the results. They plan simple tests to programmed solutions and make simple modifications to programs when requirements change.
- They provide comments on the way they and others produce and use computer solutions.
- Candidates demonstrate some awareness of the need for safe, secure, and responsible practices.

6. Curriculum Content

Section 1: Theory of Computer Science

1.1 Data Representation

Candidates should be able to:

1.1.1 Binary systems

- recognize the use of binary numbers in computer systems
- convert denary numbers into binary and binary numbers into denary
- show understanding of the concept of a byte and how the byte is used to measure memory size
- use binary in computer registers for a given application (such as in robotics, digital instruments, and counting systems)

1.1.2 Hexadecimal

- represent integers as hexadecimal numbers
- show understanding of the reasons for choosing hexadecimal to represent numbers
- convert positive hexadecimal integers to and from denary
- convert positive hexadecimal integers to and from binary
- represent numbers stored in registers and main memory as hexadecimal
- identify current uses of hexadecimal numbers in computing, such as defining colors in Hypertext Markup Language (HTML), Media Access Control (MAC) addresses, assembly languages and machine code, debugging, etc.

1.1.3 Data storage

- show understanding that sound (music), pictures, video, text, and numbers are stored in different formats
- identify and describe methods of error detection and correction, such as parity checks, check digits, checksums, and Automatic Repeat reQuests (ARQ)
- show understanding of the concept of Musical Instrument Digital Interface (MIDI) files, jpeg files, MP3, and MP4 files
- show understanding of the principles of data compression (lossless and lossy compression algorithms) applied to music/video, photos, and text files

1.2 Communication and Internet Technologies

Candidates should be able to:

1.2.1 Serial and parallel data transmission

- show understanding of what is meant by transmission of data
- distinguish between serial and parallel data transmission
- show understanding of the reasons for choosing serial or parallel data transmission
- show understanding of the need to check for errors
- explain how parity bits are used for error detection
- identify current uses of serial and parallel data transmission, e.g. Integrated Circuits (IC) and Universal Serial Bus (USB)

1.2.2 Security aspects

- show understanding of the security aspects of using the Internet and understand what methods are available to help minimize the risks
- show understanding of the Internet risks associated with malware, including viruses, spyware, and hacking
- explain how antivirus and other protection software helps to protect the user from security risks (this also links into section 1.4 of the syllabus)

1.2.3 Internet principles of operation

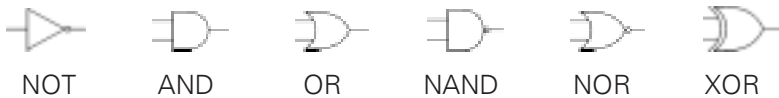
- show understanding of the role of the browser and Internet server
- show understanding of what is meant by hypertext transfer protocol (http) and HTML
- distinguish between HTML structure and presentation
- show understanding of the concept of MAC address, Internet Protocol (IP) address, and cookies

1.3 Hardware and Software

Candidates should be able to:

1.3.1 Logic gates

- use logic gates to create electronic circuits
- understand and define the functions of NOT, AND, OR, NAND, NOR, and XOR (EOR) gates, including the binary output produced from all the possible binary inputs (all gates, except the NOT gate, will have 2 inputs only)
- draw truth tables and recognize a logic gate from its truth table
- recognize and use the following standard symbols used to represent logic gates:



- produce truth tables for the given logic circuits, for example:

a	b	c	out
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

- produce a logic circuit to solve a given problem or to implement a given written logic statement, such as (IF switch A is NOT on) OR (switch B is on AND switch C is NOT on) then alarm, X, sounds

1.3.2 Computer architecture and the fetch-execute cycle

- show understanding of the basic Von Neumann model for a computer system and the stored program concept (program instructions and data are stored in main memory and instructions are fetched and executed one after another)
- describe the stages of the fetch-execute cycle

1.3.3 Input devices

- describe the principles of operation (how each device works) of a range of input devices including 2D and 3D scanners, barcode readers, digital cameras, keyboards, mice, touch screens, microphones
- describe how these principles are applied to real-life scenarios, for example: scanning of passports at airports, barcode readers at supermarket checkouts, and touch screens on mobile devices
- describe how a range of sensors can be used to input data into a computer system, including light, temperature, magnetic field, gas, pressure, moisture, humidity, pH/acidity/alkalinity, and motion/infra-red
- describe how these sensors are used in real-life scenarios, for example: street lights, security devices, pollution control, games, and household and industrial applications

1.3.4 Output devices

- describe the principles of operation of a range of output devices, including: inkjet, laser, and 3D printers; 2D and 3D cutters; speakers and headphones; actuators; flat-panel display screens, including Liquid Crystal Display (LCD) and Light-Emitting Diodes (LED); and LCD projectors and Digital Light Projectors (DLP)
- describe how these principles are applied to real-life scenarios, for example: printing single items on demand or in large volumes; banks of digital displays; use of small screens on mobile devices; smart boards

1.3.5 Memory, storage devices, and media

- show understanding of the difference between: primary, secondary, and off-line storage and provide examples of each, such as: primary: Read Only Memory (ROM), Random Access Memory (RAM), and DVD-RAM; secondary: hard disk drive (HDD) and Solid State Drives (SSDs); off-line: Digital Versatile Disks (DVDs), Compact Disks (CDs), Blu-ray, USB flash memory, and removable disks
- describe the principles of operation of a range of types of storage devices and media, including magnetic, optical, and solid state
- describe how these principles are applied to currently available storage solutions, such as SSDs, hard disk drives, USB flash memory, DVDs, CDs, and Blu-ray
- calculate the storage equipment of a file

1.3.6 Operating systems

- describe the purpose of an operating system
- show understanding of the need for interrupts

1.3.7 High- and low-level languages and their translators

- show understanding of the need for both high-level and low-level languages
- show understanding of the need for compilers when translating programs written in a high-level language
- show understanding of the use of interpreters with high-level language programs
- show understanding of the need for assemblers when translating programs written in assembly language

1.4 Security

Candidates should be able to:

1.4.1

- show understanding of the need to keep data safe from accidental damage, including corruption and human errors
- show understanding of the need to keep data safe from malicious actions, including unauthorized viewing, deleting, copying, and corrupting

1.4.2

- show understanding of how data are kept safe when stored and transmitted, including:
 - use of passwords, both entered at a keyboard and biometric
 - use of firewalls, both software and hardware, including proxy servers
 - use of Secure Socket Layer (SSL)
 - use of symmetric encryption (plain text, cypher text, and use of a key) showing understanding that increasing the length of a key increases the strength of the encryption

1.4.3

- show understanding of the need to keep online systems safe from attacks, including denial of service attacks, phishing, pharming

1.4.4

- describe how the knowledge from 1.4.1, 1.4.2, and 1.4.3 can be applied to real-life scenarios including, for example, online banking, shopping

1.5 Ethics

Candidates should be able to:

- show understanding of computer ethics, including copyright issues and plagiarism
- distinguish between free software, freeware, and shareware
- show understanding of the ethical issues raised by the spread of electronic communication and computer systems, including hacking, cracking, and production of malware

Section 2: Practical Problem-solving and Programming

2.1 Algorithm Design and Problem-solving

Candidates should be able to:

2.1.1 Problem-solving and design

- show understanding that every computer system is made up of subsystems, which in turn are made up of further subsystems
- use top-down design, structure diagrams, flowcharts, pseudocode, library routines, and subroutines
- work out the purpose of a given algorithm
- explain standard methods of solution
- suggest and apply suitable test data
- understand the need for validation and verification checks to be made on input data (validation could include range checks, length checks, type checks, and check digits)
- use trace tables to find the value of variables at each step in an algorithm
- identify errors in given algorithms and suggest ways of removing these errors
- produce an algorithm for a given problem (either in the form of pseudocode or flowchart)
- comment on the effectiveness of a given solution

2.1.2 Pseudocode

- understand and use pseudocode for assignment, using \leftarrow
- understand and use pseudocode, using the following conditional statements:
`IF ... THEN ... ELSE ... ENDIF`
`CASE ... OF ... OTHERWISE ... ENDCASE`
- understand and use pseudocode, using the following loop structures:
`FOR ... TO ... NEXT`
`REPEAT ... UNTIL`
`WHILE ... DO ... ENDWHILE`
- understand and use pseudocode, using the following commands and statements:
`INPUT and OUTPUT (e.g., READ and PRINT)`
`totaling (e.g., Sum \leftarrow Sum + Number)`
`counting (e.g., Count \leftarrow Count + 1)`

(Candidates are advised to try out solutions to a variety of different problems on a computer using a language of their choice; no particular programming language will be assumed in this syllabus.)

2.2 Programming

Candidates should be able to:

2.2.1 Programming concepts

- declare and use variables and constants
- understand and use basic data types: Integer, Real, Char, String, and Boolean
- understand and use the concepts of sequence, selection, repetition, totaling, and counting
- use predefined procedures/functions

2.2.2 Data structures; arrays

- declare the size of one-dimensional arrays, for example: A[1:n]
- show understanding of the use of a variable as an index in an array
- read values into an array using a FOR ... TO ... NEXT loop

2.3 Databases

Candidates should be able to:

- define a single-table database from given data storage requirements
- choose a suitable primary key for a database table
- perform a query-by-example from given search criteria

7. Description of Components

7.1 Scheme of Assessment

All candidates need to demonstrate basic levels of knowledge and understanding. To do this, they need to recall information and either apply that information or explain it. All candidates also need to demonstrate some level of problem-solving and practical skills. This will require them to show their ability to comprehend and analyze computational tasks and design, implement, test, and evaluate solutions using a variety of methods.

Component 1: Paper 1 Theory

This is a mandatory question paper, consisting of short-answer and structured questions set on Section 1 of the syllabus. Candidates must answer all questions. Candidates will answer on the question paper.

Component 2: Paper 2 Problem-solving and Programming

This is a mandatory question paper, consisting of short-answer and structured questions set on Section 2 of the syllabus. Candidates must answer all questions. Candidates will answer on the question paper. 20 of the marks in this paper are from questions set on tasks provided in the Paper 2 Problem-solving and Programming pre-release materials.

Centers should spend approximately 50% of the total time studying this section of the syllabus. Centers should ensure that candidates are taught the contents of this section in a largely practical way. Candidates will be expected to be able to program in a high-level programming language to be chosen by the Center. The programming language should be procedural. There will be some examining of knowledge with understanding, but the bulk of the credit will be for using techniques and skills to solve problems. In all cases the logic will be of more importance than the syntax.

7.2 Paper 2 Problem-solving and Programming Pre-release Materials

The Paper 2 Problem-solving and Programming pre-release materials will be made available to Centers six months before the exam. Centers are advised to encourage their candidates to develop solutions to tasks using a high-level programming language, such as Visual Basic, Pascal/Delphi, or Python. The purpose of the pre-release material tasks is to direct candidates to some of the topics that will be examined in Paper 2. Teachers are expected to incorporate these tasks into their lessons and give support in finding methods and reaching solutions. 20 of the marks in this paper will be from questions testing candidates' understanding gained from developing programmed solutions to these tasks. The tasks will be appropriate for all ability levels.

The exam questions will require candidates to have practical programming experience, including writing their own programs, executing (running), testing, and debugging them. Knowledge of programming language syntax will not be examined. The higher-ability candidates are to be encouraged to extend their practical programming beyond the scope of these tasks.

8. Notes for the Guidance of Teachers

Introduction

The purpose of these notes is to provide assistance for teachers preparing candidates for the Cambridge IGCSE Computer Science examination. They contain notes on equipment, facilities, and resources and sources of further information.

Equipment and Facilities

Computer science is a practical subject and the Cambridge IGCSE syllabus places emphasis on the use of procedural high-level programming languages. Centers must ensure that their equipment and facilities are adequate for candidates to be able to satisfy the requirements of the syllabus. The hardware facilities needed will depend on the number of candidates, but should be sufficient for all candidates to have enough time to practice their programming skills.

Hardware

Candidates need to have access to a system with direct-access file capability on backing store and hardcopy facilities.

Software

Candidates should have experience using a high-level programming language, such as Visual Basic, Pascal/Delphi, or Python, chosen by the Center.

Books

Provision of textbooks is difficult as new titles are available all the time. The British Computer Society (BCS) book list for schools and colleges lists books that are suitable for use as reference books. Teachers will need to consult several books to cover the whole syllabus adequately. There is a suggested book list on our website. Many schools prefer to have a wide range of reference books rather than a class textbook.

Practical Skills

Computer science is a practical subject and a range of practical exercises should supplement the study of most parts of the syllabus.

It is important that Centers encourage candidates, as early as possible in the course, to develop a systematic approach to practical problem solving using appropriate resources.

9. Other Information

Equality and Inclusion

Cambridge has taken great care in the preparation of this syllabus and assessment materials to avoid bias of any kind. To comply with the UK Equality Act (2010), Cambridge International Examinations has designed this qualification with the aim of avoiding direct and indirect discrimination.

The standard assessment arrangements may present unnecessary barriers for candidates with disabilities or learning difficulties. Arrangements can be put in place for these candidates to enable them to access the assessments and receive recognition of their attainment. Access arrangements will not be agreed to if they give candidates an unfair advantage over others or if they compromise the standards being assessed.

Candidates who are unable to access the assessment of any component may be eligible to receive an award based on the parts of the assessment they have taken.

Information on access arrangements is found in the *Cambridge Handbook*, which can be downloaded from the website **www.cie.org.uk**

Language

This syllabus and the associated assessment materials are available in English only.

Grading and Reporting

Cambridge IGCSE Certificate results are shown by one of the grades A*, A, B, C, D, E, F, or G indicating the standard achieved, grade A* being the highest and grade G the lowest. "Ungraded" indicates that the candidate's performance fell short of the standard required for grade G. "Ungraded" will be reported on the statement of results but not on the certificate. The letters Q (result pending), X (no results), and Y (to be issued) may also appear on the statement of results but not on the certificate.

Entry Codes

To maintain the security of our examinations we produce question papers for different areas of the world, known as "administrative zones." Where the component entry code has two digits, the first digit is the component number given in the syllabus. The second digit is the location code, specific to an administrative zone. Information about examination timetables, administrative instructions, and entry codes for your administrative zone can be found in the *Cambridge Guide to Making Entries*.

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