OXFORD AQA
INTERNATIONAL QUALIFICATIONS

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OxfordAQA International AS/A-level
Computer Science (9645)

Switching guide

Switching from Cambridge International Examinations to Oxford International AQA Examinations

Key differences

The most significant differences between the two specifications are:

1. **Method of assessment of programming skills** – OxfordAQA assess all programming using the programming language that the student has studied, in both the Unit 1 and Unit 3 exams. CIE assess programming through the use of pseudocode in Paper 2 and programming using a language in Paper 4, meaning that students have to be familiar with two different methods of writing code.

2. **Breakdown of theory topics** – the OxfordAQA specification has been designed so that topics only need to be taught for one unit – different aspects of the same topic are not assessed in both the first and second year of the course. For example, all of the content relating to computer hardware and software is assessed in the Unit 2 exam for OxfordAQA, but it is split between sections 3 and 4 (assessed in Paper 1) and sections 15 and 16 (assessed in Paper 3) for CIE. The same is true for other topics, such as data representation, networking and security where the CIE content is assessed in two different papers, but the OxfordAQA content is assessed in only one.

3. **Assessment objectives weightings** – the assessment objectives for the OxfordAQA specification award significantly more credit for programming skills that the CIE specification does. There is a greater focus on being able to apply skills than on learning and recalling content

4. **Specification detail** – the OxfordAQA specification contains greater detail on exactly what students need to know for their exams, to help you prepare them with confidence.

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Assessment comparison

OxfordAQA Exams specification (9645)	Cambridge International Examinations (CIE) specification (9618)
Four exam papers: **Unit 1**: Programming 2:00 75 marks **Unit 2**: Concepts and principles of computer science 1:30 75 marks **Unit 3**: Advanced Programming 2:30 90 marks **Unit 4**: Advanced concepts and principles of computer science 1:30 75 marks Units 1 and 2 are worth 50% of the AS each. Units 1 and 2 are worth 20% of the A-level each and Units 3 and 4 are worth 30% of the A-level each. The Unit 1 and 3 programming exams are both completed on-screen using C#, Python or VB.Net.	Four exam papers: **Paper 1**: Theory Fundamentals 1:30 75 marks **Paper 2**: Fundamental Problem-solving and Programming Skills 2:00 75 marks **Paper 3**: Advanced Theory 1:30 75 marks **Paper 4**: Practical 2:30 75 marks Papers 1 and 2 are worth 50% of the AS each. Each paper is worth 25% of the A-level. Responses to Paper 2 are written using pseudocode. The Paper 4 exam can be taken using Java, Python or VB.Net.
Three assessment objectives: **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 in order to develop and test programmed solutions and demonstrate an understanding of programming concepts. Assessment objective weightings:	Three assessment objectives: **AO1**: Demonstrate knowledge and understanding of the principles and concepts of computer science, including abstraction, logic, algorithms and data representation. **AO2**: Apply knowledge and understanding of the principles and concepts of computer science, including to analyse problems in computational terms. **AO3**: Design, program and evaluate computer systems to solve problems, making reasoned judgements about these. Assessment objective weightings:

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	AO1	AO2	AO3			AO1	AO2	AO3
AS	27.5%	17.5%	55%		AS	30%	40%	30%
A-level	27%	16%	57%		A-level	30%	30%	40%

Topic by topic comparison

OxfordAQA Exams specification (9645)	Cambridge International Examinations (CIE) specification (9618)
3.1.1 Data types	This is covered in section 10.1 of the CIE specification; the data types required are the same for both specifications. In section 13.1 the CIE specification also requires students to be able to use enumerated and pointer types, which are not required for OxfordAQA.
3.1.2 Programming concepts – declaration, assignment, selection, iteration (definite and indefinite), input and output, comments, arithmetic operations, relational operations, Boolean operations, string-handling operations, random number generation, exception handling, subroutines, parameters, return values, global and local variable, the stack frame.	This is covered in sections 11.1, 11.2 and 11.3 of the CIE specification and most of the content is similar. Minor differences are: • CIE requires students to distinguish between procedures and functions, which is not required by OxfordAQA. • CIE requires students to be able to write pseudocode; OxfordAQA only requires students to be able to write program code, using their chosen language and to be able to read pseudocode. • OxfordAQA requires students to understand variable scope, including global and local and also the use of the stack frame, neither of which are required by CIE.
3.2 Fundamental data structures – static and dynamic, arrays (one and two-dimensional) and lists, records, queues (linear and circular), stacks.	The CIE specification covers one and two-dimensional arrays in section 10.2 and records in section 10.1. The contents on these topics are the same as for OxfordAQA. In section 10.4, CIE requires students to use linked lists, which OxfordAQA does not. Instead, OxfordAQA requires students to use lists which are not required by CIE.

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	Both specifications cover stacks and queues, but there is some additional content for the OxfordAQA specification which requires students to distinguish between linear and circular queues and also to have used a programming language library for stacks and queues.
3.3 Program design – structured approach, abstraction and decomposition, algorithms and pseudocode, hand-tracing algorithm, aspects of software development.	CIE covers structured programming in sections 11.3 and 12.2 of the specification. The content is broadly similar, but CIE require students to distinguish between procedures and functions, which OxfordAQA do not. OxfordAQA requires students to be able to use both hierarchy and structure charts. CIE require the use of structure charts and (in section 11.1) flowcharts, which are not required for OxfordAQA.

CIE covers abstraction and decomposition in section 9.1 of the specification, with similar content to OxfordAQA.

Algorithms are covered in section 9.2 of the CIE specification. For both CIE and OxfordAQA, students are required to be able to define the term algorithm. CIE require that students are able to write algorithms in pseudocode and using flowcharts, which is not required by OxfordAQA.

OxfordAQA requires students to be able to hand-trace an algorithm. CIE only state that this is required for recursive algorithms, and algorithms written in assembly language.

CIE cover aspects of software development in sections 12.1 to 12.3 of their specification. The content in relation to each of the stages (analysis, design, implementation, testing, evaluation) is similar to |

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	OxfordAQA. CIE requires students to cover additional content that is not required for OxfordAQA, including types of testing, maintenance and different models of life cycle such as waterfall and iterative.
3.4 Searching and sorting algorithms - linear search, binary search, bubble sort, merge sort.	Searching and sorting algorithms are covered in section 19.1 of the CIE specification. The content is mostly similar, the only significant difference being that instead of a merge sort, CIE requires students to understand the insertion sort method.
3.5 Representing data – number bases (decimal, binary, hexadecimal), units of information, binary numbers (including unsigned, signed two's complement, fixed point, floating point, errors, underflow and overflow), representing characters, graphics (bitmap and vector), sound, basic encryption, error detection and correction.	Numbers are covered in sections 1.1 and 13.3 of the CIE specification. The content relating to binary numbers and hexadecimal is similar. OxfordAQA requires students to be able to calculate absolute and relative errors for floating point, which CIE do not. CIE requires students to use BCD and to understand one's complement in addition to two's complement; OxfordAQA only requires two's complement. Both specifications require students to be able to perform binary addition and subtraction, the OxfordAQA specification also requires multiplication.

Units of information are covered in section 1.1 of the CIE specification, with similar content to OxfordAQA.

Representing characters is covered in section 1.1 of the CIE specification. The OxfordAQA specification is more detailed in its content and requires students to have an awareness of different types of Unicode, which CIE do not. CIE covers extended ASCII, which is not required by OxfordAQA.

Graphics and sound are covered in section 1.2 of the CIE specification; the content is similar to the OxfordAQA content, with the only significant differences being that the OxfordAQA |

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	specification covers Nyquist's theorem and requires students to be able to sound file size calculations. The OxfordAQA specification includes the use of the Caesar Cipher and Vernam Cipher encryption methods, which CIE does not, although there is some general content on encryption in section 17.1. The OxfordAQA specification covers some methods of error detection including parity bits, checksums and majority voting. Parity bits and checksums are covered in section 6.2 of the CIE specification, which does not require students to cover majority voting. The CIE specification also covers the topics of visual check and double entry as methods of data verification, which are not covered by OxfordAQA. The CIE specification covers compression in section 1.3, which is not required for OxfordAQA.
3.6 Computer systems – hardware and software, application and system software, the operating system, classification of programming languages, translation.	The OxfordAQA specification requires students to distinguish between application and system software, which is not required by CIE. Operating systems are covered in sections 5.1 and 16.1 of the CIE specification. CIE requires students to know significantly more about the functions of an operating system than OxfordAQA do, including topics such as scheduling methods and virtual memory management. The CIE specification requires students to be able to use both low-level and high-level languages but does not explicitly require them

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	to be able to compare the two types of languages, which the OxfordAQA specification requires in section 3.6.3.1. Translation is covered in sections 5.2 and 16.2 of the CIE specification. The CIE specification has additional content relating to the features of an IDE and the stages of compilation, which are not required by OxfordAQA. The OxfordAQA specification has more content on intermediate languages such as bytecode than the CIE specification does.
3.7 Computer organisation and architecture – internal components, memory, the stored program concept, Harvard and von Neumann architectures, processor components, registers, the fetch-execute cycle, interrupts, performance factors, secondary storage, the cloud, logic gates, Boolean algebra.	Computer hardware is covered in sections 3.1, 4.1 and 15.1 of the CIE specification. The content on the roles of key components is similar for both specification. The OxfordAQA specification requires a student to be able to compare the Harvard and von Neumann architectures, but the CIE specification only covers the von Neumann architecture. The content relating to processor components, the fetch-execute cycle, interrupts and secondary storage is similar between the two specifications. A minor difference is that for CIE students must be able to use register transfer notation; this is not required for OxfordAQA. The range of factors that the OxfordAQA specification covers relating to performance is slightly broader than the CIE specification.

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	The CIE specification covers cloud computing in section 2.1; the scope of the topic is not clear. For the OxfordAQA specification, only cloud storage is covered. Logic gates are covered in sections 3.2 and 15.2 of the CIE specification. The content is similar to the OxfordAQA content, but the types of flip-flop covered are different and the AQA specification only covers gates with one or two inputs. For both specifications, students need to cover half and full-adder circuits. Boolean algebra is covered in section 15.2 of the CIE specification. The CIE specification also requires students to be able to use Karnaugh maps for simplification, which is not required by OxfordAQA. The CIE specification covers the following topics which are not required by OxfordAQA: • embedded systems • laser printer • 3D printer • microphone • speakers • touchscreen • virtual reality headset • buffers • comparing SRAM and DRAM • comparing PROM, EPROM and EEPROM • monitoring and control systems • USB, HDMI, VGA • RISC vs CISC • SISD, SIMD, MISD, MIMD

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	• massively parallel architectures • virtual machines.
3.8 Machine code and assembly language – instruction set and format, opcode and operand, addressing modes (immediate, direct, indirect), assembly language programming including writing and tracing programs.	This is covered in sections 4.2 and 4.3 of the CIE specification. Both specifications have a standard instruction set that will be used in exam questions. The OxfordAQA instruction set is based on the ARM instruction set, which the CIE instruction set is not, although the range of operations covered is similar. The CIE specification requires students to be able to use the indexed and relative addressing modes and to describe the stages of a two-pass assembler, which OxfordAQA does not require.
3.9 Object-oriented and additional programming – know why OOP is used, class, properties, method, object, instantiation, encapsulation, getters and setters, inheritance, overriding, association, constructors, class diagrams, text files, recursion.	The use of a "class/object" as a data type is covered in section 13.1 of the CIE specification and object-oriented programming is covered in section 20.1. The concepts that need to be covered are very similar for both specifications. For the OxfordAQA specification, students need to be able to understand class diagrams, which are not referenced in the CIE specification. The OxfordAQA specification only requires students to be able to use text files, which are covered in section 10.3 of the CIE specification. The CIE specification has additional content in sections 13.2 that is not required for OxfordAQA, relating to non-text files, including serial, sequential and random files. Recursion is covered in section 19.2 of the CIE specification, with content similar to the OxfordAQA specification.

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3.10 Advanced data structures – graphs, trees, binary trees, hash tables, priority queues, dictionaries.	The data structures covered by both specifications are similar, but there are some differences. The graph data structure is covered in sections 18.1 of the CIE specification which is about artificial intelligence and section 19.1. For the CIE specification, students need to understand what graphs are but are not required to write algorithms to use graphs. For the Oxford AQA specification, students need to understand how a graph can be implemented using an adjacency list or adjacency matrix and the relative merits of these two methods, which is not required by CIE. Section 19.1 also covers binary trees, but not trees in general, which are required for the Oxford AQA specification. Hash tables are not required for the CIE specification, but the use of hashing for file access, which is very similar, is covered in section 13.2 of the specification. Priority queues are not explicitly covered by the CIE specification, but are often used to implement Dijkstra's algorithm, which is covered in section 18.1. Dictionaries are covered in section 19.1. The CIE specification covers linked lists, which are not required for OxfordAQA.
3.11 Advanced algorithms – depth-first and breadth-first graph traversals, tree traversals, Dijkstra's shortest-path algorithm.	The OxfordAQA specification requires students to be able to use depth-first and breadth-first graph traversals and tree traversals, which are not covered by the CIE specification.

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	In addition to being able to use Dijkstra's algorithm, which is required by OxfordAQA, students following the CIE specification also need to be able to use the A* algorithm, which is covered in section 18.1 of the specification.
3.12 Functional programming – the functional programming paradigm, writing functional programs, lists.	Students are required to have a basic understanding of this increasingly popular style of coding for the OxfordAQA specification. It is not required for the CIE specification, which instead covers declarative languages in section 20.1. Some concepts that are important to functional programming are covered in other parts of the CIE specification, most notably recursion in section 19.2.
3.13 Theory of computation – finite state machines, regular expressions and regular languages, Turing machines, Bakus-Naur Form (BNF) and syntax diagrams, classification of algorithms (efficiency, Big-O, tractability, heuristics, computability, the Halting problem).	The topics of finite state machines, regular expressions and regular languages and Turing machines, which are theoretical models underpinning Computer Science are not required by CIE. Backus-Naur Form and syntax diagrams are covered by the CIE specification in section 16.2. This section also includes Reverse Polish Notation, which is not required by OxfordAQA. The efficiency of algorithms is covered in section 19.1 of the CIE specification. The CIE specification requires students to use Big-O notation to describe the time and space complexity of algorithms. For OxfordAQA, the requirement is only to use it to specify the time complexity of an algorithm. The OxfordAQA specification contains additional content in relation to the categorisation of algorithms as being tractable, intractable, computable or non-computable as well as the use of heuristics for intractable problems and the Halting problem.

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3.14.1 Communications – parallel and serial, synchronous and asynchronous, start and stop bits, baud rate, bit rate, bandwidth, latency, protocol.	CIE only require students to understand bit rate (section 2.1) and protocol (section 14.1), although an understanding of parallel and serial would be useful for section 4.1 which covers USB and buses.
3.14.2 Networking – types of networking (peer-to-peer, client-server), thin and thick client, wired and wireless networking, the Internet, the TCP/IP model, standard protocols, IP addresses, DHCP, firewalls, asymmetric encryption, digital certificates and digital signatures, malware.	Networking is covered in sections 2 and 14 of the CIE specification. The content on peer-to-peer vs client-server and thin-client vs thick-client is similar in both specifications. The content on wired and wireless networking is similar, including the differences between them and the hardware required for each. With regard to the underlying protocols, the CIE specification covers CSMA/CD whilst the OxfordAQA specification covers both CSMA/CD used for wired networking and the CSMA/CA protocol used for wireless networking. The OxfordAQA specification also covers methods for securing a wireless network, which are not required by CIE. Both specifications cover packet switching, packets and how data is routed across the Internet. Both specifications also cover the TCP/IP model and standard protocols. The content is similar, with the OxfordAQA specification including the HTTPS and SSH protocols which CIE do not require and the CIE specification covering the BitTorrent protocol which OxfordAQA do not require. The content on IP addresses is similar on both specifications. The OxfordAQA specification requires students to understand the use of DHCP, which the CIE specification does not, whilst the CIE specification requires students to know the difference between

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	static and dynamic IP addresses, which the OxfordAQA specification does not. The CIE specification covers URLs and DNS, the OxfordAQA specification has a little more content relating to domain names, FQDNs and Internet Registries, which are all related to URLs and DNS. The cyber security content of the OxfordAQA specification is covered in sections 6.1 and 17.1 of the CIE specification. The OxfordAQA specification covers firewalls, asymmetric encryption, digital certificates and digital signatures, and protecting against malware. The CIE specification covers all of these topics, and a number of security topics that are not required by OxfordAQA (see below). There are a number of topics covered by the CIE specification that are not required by OxfordAQA. These are: • benefits of networking • LAN and WAN • topologies • modems, PSTN, dedicated lines, cell phone • bit streaming and the BitTorrent protocol • circuit switching • hackers, phishing, pharming • user accounts, passwords, biometrics, access rights • quantum cryptography • SSL and TTS.

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3.15 Databases – conceptual database modelling, E-R diagrams, relational databases, normalisation, SQL, client-server databases, big data including the fact-based model and graph schema.	Databases are covered in section 8 of the CIE specification and most of the content is similar. With regard to SQL, there are a small number of differences: • OxfordAQA do not require students to be able to use the CREATE DATABASE or ALTER TABLE commands and are more flexible about acceptable data types than CIE. • OxfordAQA require students to be able to use the MIN and MAX functions, which CIE do not. The OxfordAQA specification has a section (3.15.1.5) on client-server databases, about concurrent access and record locks, that is not included in the CIE specification. The OxfordAQA specification covers big data (section 13.15.2). This is not covered by the CIE specification. There are a small number of concepts covered by CIE that are not required by OxfordAQA, which are: • the file-based approach • use of the terminology tuple, candidate key, secondary key, referential integrity, indexing • the features provided by a DBMS
3.16 Artificial Intelligence (AI) – applications of AI, creating artificially intelligent systems, benefits and risks of artificial intelligence.	This is covered in section 18 and 7 of the CIE specification. The OxfordAQA specification requires students to know about four specific application areas of AI. These are: generative AI, search

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	and recommendation systems, strategic games and medical diagnosis. The CIE specification includes a more general statement that students must understand the applications of AI, without specifying these. Both specifications cover similar methods used by AI systems, including neural networks, back propagation, deep learning and machine learning. The CIE specification covers Dijkstra's algorithm in the context of AI, but in the OxfordAQA specification it is covered elsewhere. The CIE specification covers the A* algorithm, which OxfordAQA does not. The benefits and risks of AI are covered by OxfordAQA. The CIE requirement is slightly different; students are required to understand the impact of AI including social, economic and environmental issues.
Other topics covered by CIE that are not covered by OxfordAQA	Section 7 of the CIE specification covers ethics and ownership, including professional bodies, copyright legislation, software licenses and the impact of AI. The only part of this topic that is required by OxfordAQA is the impact of AI.