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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Computing 5511/6511
2008

Material accompanying this Specification:

- Reports on the Examination
- Past Papers and Mark Schemes
- Teachers' Guide

SPECIFICATION

The specification will be published annually on the AQA Website (www.aqa.org.uk). If there are any changes to the specification centres will be notified in print as well as on the website. The version on the Website is the definitive version of the specification.

| Vertical black lines indicate a significant change or addition to the specification published for 2007.

Further copies of this specification booklet are available from:

AQA Logistics Centre, Unit 2, Wheel Forge Way, Ashburton Park, Trafford Park, Manchester, M17 1EH.
Telephone: 0870 410 1036 Fax: 0161 953 1177
or
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Registered address AQA, Devas Street, Manchester M15 6EX. *Dr Michael Cresswell Director General.*

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Background Information

1 Advanced Subsidiary and Advanced Level Specifications

1.1 Advanced Subsidiary (AS)

Advanced Subsidiary courses were introduced in September 2000 for the award of the first qualification in August 2001. They may be used in one of two ways:

- as a final qualification, allowing candidates to broaden their studies and to defer decisions about specialism;
- as the first half (50%) of an Advanced Level qualification, which must be completed before an Advanced Level award can be made.

Advanced Subsidiary is designed to provide an appropriate assessment of knowledge, understanding and skills expected of candidates who have completed the first half of a full Advanced Level qualification. The level of demand of the AS examination is that expected of candidates half-way through a full A Level course of study.

1.2 Advanced Level (AS+A2)

The Advanced Level examination is in two parts:

- Advanced Subsidiary (AS) – 50% of the total award;
- a second examination, called A2 – 50% of the total award.

Most Advanced Subsidiary and Advanced Level courses will be modular. The AS will comprise three teaching and learning modules and the A2 will comprise a further three teaching and learning modules. Each teaching and learning module will normally be assessed through an associated assessment unit. The specification gives details of the relationship between the modules and assessment units.

With the two-part design of Advanced Level courses, centres may devise an assessment schedule to meet their own and candidates' needs. For example:

- assessment units may be taken at stages throughout the course, at the end of each year or at the end of the total course;
- AS may be completed at the end of one year and A2 by the end of the second year;
- AS and A2 may be completed at the end of the same year.

Details of the availability of the assessment units for each specification are provided in Section 3.

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Specification at a Glance
Computing

at Advanced Level

AS Examination 5511	
1½ hours	Unit 1 35 % of the total AS marks *17.5 % of the total A Level marks* Short answer questions and structured questions. AS Subject Content Module 1.
1½ hours	Unit 2 35 % of the total AS marks *17.5% of the total A Level marks* Short answer questions and structured questions. AS Subject Content Module 2.
1½ hours	Unit 3 30 % of the total AS marks *15 % of the total A Level marks* Externally-assessed Practical Exercise (Module 3). (NB The Practical Exercise, set by AQA, is different for each year of examination).

Advanced Subsidiary Award: 5511

+

A2 Examination 6510	
1½ hours	Unit 4 15 % of the total A Level marks Short answer questions and structured questions. A2 Subject Content Module 4.
1½ hours	Unit 5 15 % of the total A Level marks Short answer questions and structured questions. A2 Subject Content Module 5.
	Unit 6 20 % of the total A Level marks Centre-assessed Project (Module 6).

Advanced Award: 6511

3 Availability of Assessment Units and Entry Details

3.1 Availability of Assessment Units

Examinations based on this specification are available as follows:

	Availability of Units		Availability of Qualification	
	AS	**A2**	**AS**	**A Level**
January	1 and 2	4 and 5	✓	✓
June	1, 2 and 3	4, 5 and 6	✓	✓

3.2 Sequencing of Units

In Computing, it is recommended that the units are taken in the sequence 1, 2, 3, 4, 5 and 6 although Unit 5 can be taken before Unit 4 if desired. It should be noted that the A2 modules develop and extend the content of the AS modules and, therefore, the A2 Units contain a high percentage of synoptic assessment.

3.3 Entry Codes

Normal entry requirements apply, but the following information should be noted.
The following unit entry codes should be used:

AS	A2
Unit 1 - *CPT1* Unit 2 - *CPT2* Unit 3 - *CPT3*	Unit 4 - *CPT4* Unit 5 - *CPT5* Unit 6 - *CPT6*

The **Subject Code** for entry to the AS only award is *5511*.
The **Subject Code** for entry to the Advanced Level is made up of the AS code plus the A2 code, ie *5511* plus *6511*.

3.4 Classification Codes

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

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

The classification code for this specification is 2610.

3.5	Private Candidates	This specification is available to private candidates only if they have already received a result for the coursework unit (Unit 6, the Project) which has not been used in a subject award. Entries for the coursework unit are not accepted from private candidates. Private candidates should write to AQA for a copy of '*Supplementary Guidance for Private Candidates*'.
3.6	Access Arrangements and Special Consideration	AQA pays due regard to the provisions of the Disability Discrimination Act 1995 in its administration of this specification. Arrangements may be made to enable candidates with disabilities or other difficulties to access the assessment. An example of an access arrangement is the production of a Braille paper for a candidate with a visual impairment. Special consideration may be requested for candidates whose work has been affected by illness or other exceptional circumstances. Further details can be found in the Joint Council for Qualifications (JCQ) document: Access Arrangements and Special Consideration Regulations and Guidance Relating to Candidates who are Eligible for Adjustments in Examination GCE, AEA, VCE, GCSE, GNVQ, Entry Level & Key Skills. This document can be viewed via the AQA web site (www.aqa.org.uk). Applications for access arrangements and special consideration should be submitted to AQA by the Examinations Officer at the centre.
3.7	Language of Examination	All assessment units in this subject are provided in English only.

Scheme of Assessment

4 Introduction

This GCE Computing specification complies with:

- the Subject Criteria for Computing
- the GCSE, GCE, VCE, GNVQ and AEA Code of Practice 2006/7
- the GCE Advanced Subsidiary and Advanced Level Qualification-Specific Criteria
- the Arrangements for the Statutory Regulation of External Qualifications in England, Wales and Northern Ireland; Common Criteria.

Prior level of attainment and recommended prior learning

While it is anticipated that candidates will have studied National Curriculum ICT to Key Stage 4, or an equivalent, no prior learning or knowledge of Computing is assumed.

Rationale

This specification assists the development of Key Skills. It covers both the current technologies and perceived advances in both hardware and software to enable candidates to meet the demands of a highly skilled, IT focused business and industrial sector. The specification also provides a firm basis for further studies in higher education in Computing and related subject areas. It also enables candidates to employ IT, to its maximum potential, to assist the study of most other subjects. In developing the specification, views and comments of teachers, candidates, industrialists and other 'interested' bodies have been taken into account.

5 Aims

This A and AS specification encourages candidates to:

a. develop an understanding of the main principles of solving problems using computers;

b. develop an understanding of the range of applications of computers and the effects of their use;

c. develop an understanding of the organisation of computer systems including software, data, hardware, communications and people;

d. acquire the skills necessary to apply this understanding to developing computer-based solutions to problems.

In addition, the A Level encourages candidates to:

e. develop an understanding of the main principles of systems analysis and design, methods of problem formulation and planning of solutions using computers, and systematic methods of implementation, testing and documentation;

f. develop their capacity for critical thinking, see relationships between different aspects of the subject and perceive their field of study in a broader perspective;

g. develop their project management skills and understanding of the need for team working.

6 Assessment Objectives

The Assessment Objectives are common to both AS and A Level. In the A Level specification, the assessment objectives related to the skills of analysing, designing, implementing, testing and evaluating systems are given a higher weighting because of the increased emphasis on candidates developing their own computer-based solutions to real problems.
Knowledge, understanding and skills in computing are closely linked. Candidates are required to demonstrate the following assessment objectives in the context of the content and skills prescribed.

The schemes of assessment will assess candidates' ability to:

6.1 Knowledge and Understanding (AO1)

a. describe and explain the use and impact of Computing in a range of applications and show an understanding of the characteristics of computer systems (hardware, software and communication) which allow effective solutions to be achieved;

b. describe and explain the need for and the use of various forms of data organisation and processing to support the information requirements of a particular application;

c. describe and explain the systematic development of high quality solutions to problems and the techniques appropriate for implementing such solutions;

d. comment critically on the social, economic, legal, ethical and other consequences of the use of computers.

6.2 Skills (AO2)

a. analyse a problem and identify the parts which are appropriate for a computer-based solution;

b. select, justify and apply appropriate techniques and principles to develop data structures and algorithms for the solution of problems;

c. design, implement and document an effective solution using appropriate hardware and software.

6.3 Quality of Written Communication

The quality of written communication is assessed in all assessment units where candidates are required to produce extended written material. Candidates will be assessed according to their ability to:

- select and use a form and style of writing appropriate to purpose and complex subject matter;
- organise relevant information clearly and coherently, using specialist vocabulary when appropriate;
- ensure text is legible, and spelling, grammar and punctuation are accurate, so that meaning is clear.

The assessment of the quality of written communication is included in both Assessment Objectives AO1 and AO2.

7 Scheme of Assessment – *Advanced Subsidiary (AS)*

The Scheme of Assessment has a modular structure. The Advanced Subsidiary (AS) award comprises three compulsory assessment units.

7.1 Assessment Units

Unit 1	Written Unit	1½ hours
35% of the total AS marks	65 marks	

This unit comprises short answer questions and structured questions and assesses **Module 1** of the AS Subject Content:

Computer Systems, Programming and Networking Concepts

All questions are compulsory.

Unit 2	Written Unit	1½ hours
35% of the total AS marks	65 marks	

This unit comprises short answer questions and structured questions and assesses **Module 2** of the AS Subject Content:

Principles of Hardware, Software and Applications

All questions are compulsory.

Unit 3	Written Unit	1½ hours
30% of the total AS marks	65 marks	

Practical Systems Development

This written unit comprises compulsory structured questions on a Computing Practical Exercise. The Exercise set by AQA will be different each year but will always be based on the content of Modules 1, 2 and 3 (System Development). Practical Exercise details for each examination series will be published in the Spring Term before the start of the course. This year-specific information will be notified to centres in print and on the Website. (See Sections 18-19 also).

7.2 Weighting of Assessment Objectives for AS

The approximate relationship between the relative percentage weighting of the Assessment Objectives (AOs) and the overall Scheme of Assessment is shown in the following table.

Assessment Objectives	Unit Weightings (%)			Overall Weighting of AOs (%)
	1	2	3	
Knowledge and understanding AO1	27	27	6	60
Skills AO2	8	8	24	40
Overall Weighting of Units (%)	35	35	30	100

Candidates' marks for each assessment unit are scaled to achieve the correct weightings.

8 Scheme of Assessment – *Advanced Level (AS+A2)*

The Scheme of Assessment has a modular structure. The A Level award comprises three compulsory assessment units from the AS Scheme of Assessment and three compulsory assessment units from the A2 Scheme of Assessment.

The details of the AS assessment units are given in Section 7 above and comprise the following three units.

8.1 AS Assessment Units

Unit 1 17.5% of the total A Level marks	Written Unit 65 marks	1½ hours
Unit 2 17.5% of the total A Level marks	Written Unit 65 marks	1½ hours
Unit 3 15% of the total A Level marks	Written Unit 65 marks	1½ hours

8.2 A2 Assessment Units

Unit 4 *15% of the total A Level marks*	Written Unit 65 marks	1½ hours

This unit comprises short answer and structured questions and assesses **Module 4** of the A2 Subject Content:

Processing and Programming Techniques

All questions are compulsory.

Unit 5 *15% of the total A Level marks*	Written Unit 65 marks	1½ hours

This unit comprises short answer and structured questions and assesses **Module 5** of the A2 Subject content:

Advanced Systems Development

All questions are compulsory.

Unit 6 *20% of the total A Level marks*	Centre-assessed Project 65 marks

The Practical Project is marked in the centre and moderated by AQA. The Project allows candidates to demonstrate their knowledge and understanding of computer systems and the principles of computing, and their skills at analysing, designing, implementing, testing and evaluating systems, by undertaking **one** substantial piece of work over an extended period of time. This work should complement the assessment carried out in the written unit and should be presented as a written report.

The Project should support and illustrate the practical application of the principles of problem-solving using computers and enable the candidate to demonstrate the techniques of system documentation and system development (see the Teachers' Guide for further guidance).

8.3 Synoptic Assessment

The Advanced Subsidiary and Advanced Level Criteria state that A Level specifications must include synoptic assessment (representing at least 20% of the total A Level marks). Synoptic assessment draws on both assessment objectives and is designed to test candidates' understanding of the connections between different elements of the subject.

Synoptic assessment in computing requires candidates to make connections between different areas of computing represented in the specification. In particular, candidates are required to draw on:

- their knowledge and understanding of information, software, hardware, communications, applications and effects, when demonstrating the skills associated with analysis, design, implementation and evaluation of computer-based systems, for example, apply knowledge and understanding of the methods of organising and structuring information when designing a system;
- their knowledge of hardware and communications, software and information when discussing the applications and effects of computing, for example, drawing on their understanding of the characteristics of networks when discussing the economic, social, legal, ethical and other consequences of computing.

This specification requires that the two assessment objectives are brought together in the project which makes up 20% of the A Level qualification in Module 6. In addition, the A2 modules develop, extend and link the contents of the AS modules, bringing together knowledge, understanding and skills.

Both A2 modules 4 and 5 are therefore entirely synoptic.

8.4 Weighting of Assessment Objectives for A Level

The approximate relationship between the relative percentage weighting of the Assessment Objectives (AOs) and the overall Scheme of Assessment is shown in the following table.

A Level Assessment Units (AS + A2)

Assessment Objectives	**Unit Weightings (%)**						**Overall Weighting of AOs (%)**
	1	2	3*	4	5	6†	
Knowledge and understanding (AO1)	13.5	13.5	3	6	6	5	47
Skills (AO2)	4	4	12	9	9	15	53
Overall Weighting of Units (%)	17.5	17.5	15	15	15	20	100

*Practical Exercise assessed by AQA

† Centre-assessed Project

Candidates' marks for each assessment unit are scaled to achieve the correct weightings.

Subject Content

9 Summary of Subject Content

9.1 AS Modules

MODULE 1 – Computer Systems, Programming and Networking Concepts,

The contents of this module include:

Computer systems
Programming
Information and Data Representation
Communication and Networking

MODULE 2 – Principles of Hardware, Software and Applications

The contents of this module include:

Applications and Effects
Files and databases
Operating Systems
Hardware Devices

MODULE 3 – Practical Systems Development

A Practical Exercise will be set by AQA and published each year in the Specification document (see Sections 18 - 20). The Exercise will be different each year but will always be based on the content of Modules 1, 2 and 3. The Exercise will require candidates to demonstrate at least two of the skills of:

- analysing
- designing
- implementing
- testing
- evaluating

using appropriate software. This module will be tested in Unit 3, a written paper marked by AQA. Further details can be found in Sections 18 and 19 and on the Specimen Paper for Unit 3.

9.2 A2 Modules

MODULE 4 – Processing and Programming Techniques

The contents of this module include further detail on:

Machine Level Structure
Programming Concepts
Machine operation and Assembly Language
Data Representation in Computers
Operating Systems

MODULE 5 - Advanced System Development

The contents of this module include further details on:

- Applications and Effects
- Files and databases
- Systems Development
- Hardware Devices
- Networking

MODULE 6 - The Practical Project

The centre-assessed Project enables a candidate to demonstrate the ability of drawing together knowledge, understanding and skills from all areas of the specification. In particular the Project will test the skills of analysing, designing, implementing, testing and evaluating systems in undertaking a task, in depth, over an extended period of time. It involves the organisation and presentation of a report that summarises the work carried out, including an evaluation of this work by the candidate. (See the Teachers Guide for further guidance).

10 AS Module 1 *Computer Systems, Programming and Network Concepts*

10.1 Fundamentals of Computer Systems

Hardware and Software	Candidates should understand the relationship between hardware and software and be able to define both.
Classification of Software	Candidates should be aware of how software is classified. They should be able to explain what is meant by system software and application software.
System Software	Operating system software Utility programs Library programs Compilers, assemblers, interpreters
Application Software	Candidates should be able to describe the different types of application software. General purpose applications software Special purpose applications software Bespoke software
The generation of Bit Patterns in a Computer	Explain the different interpretations that may be associated with a pattern of bits. Bits, bytes Concept of a word Program and data
Internal Components of a Computer	Outline the basic internal components of a computer system. (Although questions about specific machines will not be asked it might be useful to base this section on the machines used at the centre.) Processor, main memory, address bus, data bus, control bus, I/O port, secondary storage, their purpose and how they relate.
Functional Characteristics of a Processor	Describe the stored program concept whereby machine code instructions stored in main memory are fetched and executed serially by a processor that performs arithmetic and logical operations.

10.2 Fundamentals of Programming

Generations of Programming Language	
First generation - Machine code Second generation - Assembly language	Describe machine-code language and assembly language. Some discussion of the development of programming languages and the limitations of both machine code and assembly-language programming would be useful.
Third generation - imperative high level language	Explain the term 'imperative high level language' and its relationship to first and second generation languages.
Types of Program Translator	
Assembler Compiler Interpreter	Define each type of language translator and illustrate situations where each would be appropriate or inappropriate
Features of Imperative High Level Languages	
Data types Built-in User defined	Illustrate these features for a particular imperative, third generation language.
Programming statements Type definitions Variable declarations Constant definitions	Describe the use of these statement types.
Procedure/Function declarations Assignment Iteration Selection Procedure and function calling	Explain the advantages of procedure/functions.
Constants and variables Procedure and function parameters.	Explain the advantages of named variables and constants. Describe the use of parameters to pass data within programs.
Fundamentals of Structured Programming	Candidates should be familiar with the structured approach to program construction and should be able to construct and use structure charts when designing programs, use meaningful identifier names, procedures/functions with interfaces, use procedures that execute a single task, and avoid the use of GoTo statements. Candidates should be able to explain the advantages of the structured approach.

Abstract Data Types Binary tree Stack Linear queue	Candidates should be able to recognise and use these in very simple ways. They will not be expected to have knowledge of how to implement these in a programming language. Uses of these should include a binary search tree and using a stack to reverse the elements of a linear queue.
Data Structures	
One and two dimensional arrays	Candidates should be familiar with each of these and their uses.
Simple Algorithms	Candidates should understand the term algorithm and be able to hand trace simple algorithms.

10.3 Fundamentals of Information and Data Representation

Relationship between Data and Information	
Data	Explain the term data.
Sources of data	Consider sources of data, both direct and indirect.
Meaning of the term Information	Consider data as an encoded form of information and information as any form of communication that provides understandable and useful knowledge to the recipient.
Number Representation Systems	
Binary number system Pure binary representation of decimal integers	Describe the representation of unsigned decimal integers in binary. Perform conversion from decimal to binary and vice-versa.
Binary-coded decimal (BCD) representation	Describe the representation of unsigned decimal integers in binary-coded decimal. Perform conversions from decimal to BCD and vice versa. Explain advantages of BCD.
Information Coding Schemes	
ASCII EBCDIC Unicode	Describe standard coding systems for coding information expressed in character form and other text-based forms. Differentiate between the character code representation of a decimal integer and its pure binary representation.

Representing Images, Sound and other Information	
Bit-mapped graphics Vector graphics	Describe how bit patterns may represent other forms of information including graphics and sound.
Sampled Sound	
Sound Synthesis	
Analogue and digital signals Analogue to digital converter (ADC)	Differentiate between analogue and digital signals. Describe the principles of operation of an analogue to digital converter.

10.4 Communication and Networking

Communication Methods	
Serial data communication Parallel data communication	Define both serial and parallel methods and illustrate where they are appropriate. Consider the effect of distance on the transmission of data.
Baud rate, bit rate and bandwidth	Define these terms. Differentiate between baud rate and bit rate. Consider the relationship between bit rate and bandwidth.
Asynchronous data transmission	Define
Start and stop bits	Describe the purpose of start and stop bits in asynchronous data transmission.
Odd and even parity	Explain the use of parity checks.
Handshaking in parallel data transmission and meaning of the term protocol	Explain what is meant by a protocol in this context.
Modem	Describe the purpose and the method of operation of a modem.
Networking	
Network	Define these networking terms.
Local area network (LAN) Bus, Ring and Star LAN topologies Wide area network (WAN) The Internet Intranet Network adapter Leased line networking Dial up networking	Candidates should be familiar with LAN topologies but will not be required to know details of their operation. Candidates should be aware of the advantages and disadvantages of each LAN topology. Candidates should be able to compare local area networking with standalone operation.
Uniform Resource Locator (URL)	Describe the term URL in the context of Internetworking. .
Domain names and IP addresses	Explain the term domain name and IP address. Describe how domain names are organised

11 AS Module 2 *Principles of Hardware, Software and Applications*

11.1 Applications and Effects

A study of one Major Information Processing Application of Computing	Consider the purpose of the application. Discuss the application as an information system in the context chosen. Examine specific user-interface needs. Examine the communication requirements of the application. Discuss the extent to which the given system satisfies both the organisation's and users' needs. Discuss the economic, social, legal and ethical consequences of the application.
General Purpose Packages Database, spreadsheet, word-processing, Desk-top publishing, presentation package, e-mail	Candidates should have experience in using a database and a spreadsheet package as part of their skills' development. In addition, they should be aware of how the listed packages facilitate the execution of particular tasks. Candidates should be able to assess the suitability of a given package for a particular task as well as its limitations.
Social, Economic and Ethical Consequences of Current Uses of Computing	Discuss the social and economic implications for an individual in relation to employment, government, education and leisure. Discuss issues relating to privacy in the context of electronic mail and data. Consider the impact of encryption technology on the privacy of the individual, organisation and the state.
Legal Implications of the Use of Computers.	Discuss issues of ownership of information and programs, and protection of data. Consider current legal controls which specifically refer to computerised data and programs and the implications of current legislation, to include: Data Protection Act 1998 Computer Misuse Act 1990 Copyright, Designs and Patents Act 1988

11.2 Files and Databases

File Types	
Text and non-text (binary files) files.	Define a file. Describe the meaning of the terms, text and non-text files.
A file as a collection of records.	
Records and fields (data items), primary key field.	Illustrate how key fields are used to locate and index heterogeneous records.
Fixed and variable length records.	Describe the use of fixed and variable length records. Consider the advantages and disadvantages of each.
File structure	Define what is meant by the structure of a file.
File size	Calculate the size in bytes of a given file.
File Organisation	
Serial	Describe the organisation of these files.
Sequential	Explain hashing.
Direct access	
File Processing	Explain the principle of master and transaction files and methods used to retrieve, insert, edit and delete data.
Security and Integrity of Data in a Data Processing Environment.	
The meaning of the terms Security Integrity	Define these terms.
File Security Methods Backing up strategies Encryption	Describe hardware and software protection of online files against unauthorised access and system failure.
Data Processing Integrity Methods	Explain how corrupted data can be detected and prevented using techniques such as batch totals, control totals, hash totals, check digits, virus checking, parity checking, check sums.

Database Concepts	
Data sharing Data consistency Primary key Indexing Secondary index	Consider a database as an integrated collection of non-redundant, related data accessible from more than one application and stored in different record types together with a mechanism for linking related records. Consider how data inconsistency may arise in an application based on a separate file approach and how this is avoided in a database approach. Consider why indexing is used and how databases support multiple indexes.
Validation	Describe typical built-in validation controls.
Relational Databases	Explain the concept of a relational database. Define the terms attribute, primary key, foreign key.
Querying a Database	
Querying by Example (QBE)	Illustrate the use of QBE to extract data from several tables of a relational database.

11.3 Operating Systems

Role of an Operating System Provision of a virtual machine Resource management	Candidates should understand that the role of the operating system is to hide the complexities of the hardware from the user. In addition, it manages the hardware resources in order to provide for an orderly and controlled allocation of the processors, memories and I/O devices among the various processes competing for them.
Operating System Classification Batch Interactive Real time Network	Define each type of operating system and explain their operational characteristics.

File Management File Filename Directory Pathnames Directory structure Logical drives Access rights Backing-up Archiving	Define the term File, Filename and Directory. Describe the use of directories. Explain the relationship between the root directory and sub-directories and the use of pathnames. Explain the term access rights in the context of file management. Distinguish file backing-up from archiving.

11.4 Hardware Devices

Input and Output Devices	Consider how the application and needs of the user affect the choice of input and output devices. Candidates should be able to make appropriate selections based upon knowledge of the usage of contemporary devices. Principles of operation will **not** be required. Candidates should know that a printer is used to produce a hard copy of the source code form of a computer program and to produce a hard copy of the results of processing. A hard copy of a computer program or of output produced by a computer program is a list of program source code statements or the results of processing printed through a printer onto printer paper. When the hard copy is a list of program source code statements it is referred to as a program listing. When the hard copy is the results of processing it is referred to as a print out.
Secondary Storage Devices	Explain the need for secondary storage within a computer system and discuss the difference between archived data and directly accessible data. Compare the capacity and speed of access of various media including magnetic disk, magnetic tape, CD-ROM, CD-R, CD-RW, DVD-ROM, DVD-R, DVD-RW and flash memory. Give examples of how each might be used.

12

AS Module 3
Practical Systems Development

Assessment of Module 3 is by written paper examination. The written paper examination will test a candidate's achievement in the AQA set practical exercise by a series of questions that will rely on evidence from the candidate's report on the practical exercise and knowledge, skill and understanding acquired from studying Modules 1, 2 and 3. (see Sections 18 and 19 for further guidance).

12.1 Systems Development

The Classical Systems Life-cycle	
Problem definition / problem investigation / feasibility study, analysis, design, construction / implementation and maintenance Evaluation	Describe the stages of development and maintenance of a hardware/software system including evaluating the operational, technical and financial feasibility of developing a new system. The importance of testing the specification, design and implementation. The importance of evaluating the effectiveness of the implemented solution in meeting the users' needs.
Analysis	
Methods of gathering information Data flow Diagrams	Describe methods of deriving the user and information requirements of a system and its environment. Evaluate the feasibility of a computer-based solution to a problem, specify and document the data flow and the processing requirements for a system to level one and identify possible needs for the development and maintenance of the system.
Entity-Relationship Diagrams	Produce a data model from the given data requirement for a simple scenario involving two or three entities.
Design	
Modular and top-down design Pseudo-code Simple algorithm design	Specify and document a design that meets the requirements of the problem in terms of human computer interface (usability and appropriateness), hardware and software, using methods such as structure charts, hierarchy charts, pseudo-code, relations.
Prototyping	Define prototyping.
Human Computer Interface	Examine and document specific user interface needs.

Testing Strategies	Dry run testing. Unit testing. Integration testing. Identify suitable test data. Test solution.
Construction / Implementation	Make use of appropriate software tools and techniques to construct a solution to a real problem.
Maintenance	Understand the need for and nature of maintenance. Understand how technical documentation aids the process of maintenance.
Evaluation	Evaluate methods and solutions on the basis of effectiveness, usability, and maintainability.

13 A2 Module 4 *Processing and Programming Techniques*

13.1 Machine Level Structure, Operation and Assembly Language Programming

Structure and Role of the Processor	
Arithmetic Logic Unit, Accumulator and Control Unit. Clock.	Explain the role and operation of a processor and its major components. Explain the effect of clock speed, word length and bus width on performance.
General purpose and dedicated registers.	
Machine code and processor instruction set. The Fetch-Execute cycle and the role of registers within it.	Explain how the FE cycle is used to execute machine code programs including the stages in the process with details of registers used.
Processing Concepts	
Interrupts in the context of the FE cycle.	Define an interrupt, showing how it might be used within the computer system and its effects. Describe the vectored interrupt mechanism.
Addressing modes including direct, indirect, immediate, indexed and base register addressing.	Describe the various modes of addressing memory and justify their use. Examples from actual machines might be useful.
Assembly language instructions and their relationship to machine code, memory addressing and use of the registers.	Describe the nature and format of assembly language statements. Illustrate their use for elementary machine operations.

13.2 Programming Concepts

High Level Languages	
The characteristics and classification of high level languages.	Examine the characteristics and use of a number of high level languages, (including both declarative and imperative) for developing applications.
Choice of programming languages to develop particular applications.	Discuss criteria for selecting programming languages for particular tasks.
Programming Paradigms	Candidates should have practical experience of at least one programming paradigm and should have knowledge of and reasons for the range of paradigms references in section 13.2. Candidates should be aware of the application areas for which particular paradigms are best suited.
Imperative and declarative languages.	Distinguish between programming language types and generations.
Structured programming techniques. Procedural-oriented programming.	
Object-oriented programming.	Candidates should be familiar with the concept of an object, an object class, encapsulation, inheritance, polymorphism, associations and containment (fixed and variable aggregation), and event-driven programming.
Logic programming	Candidates should be familiar with the concept of logic programming for declaring logical relationships.
Data Structures	
Lists Trees Queues - linear and circular Stacks Pointers	Candidates should be familiar with the concept of a list, a tree, a queue, a stack, a pointer and be familiar with the methods (data structures) for representing these when a programming language does not support these as built-in types.
Linked lists.	Distinguish between static and dynamic structures and compare their uses. Use of free memory, heap and pointers.
Standard Algorithms	
Linear search Binary search Bubble sort Tree traversal algorithms Stack, queue and list operations Creating and maintaining linked lists.	Describe, using algorithms or programming examples, the methods used by programmers when manipulating structured data. Discuss methods used in relation to efficiency criteria. Candidates should be aware of the link between choice of algorithms and volume of data to be processed. Describe the creation and maintenance of data within lists, trees, stacks, queues and linked lists.
Recursive Techniques	Illustrate the use of recursive techniques in both procedural and logic programming languages.

13.3 Data Representation in Computers

The concept of number bases denary, binary and hexadecimal	Describe the conversion of a denary number to binary form and vice versa. Describe the conversion of a denary number to hexadecimal form and vice versa. Describe the use of hex as shorthand for binary.
Number Representation	
Integer and real numbers	Draw a distinction between integers and reals in a computer context. Describe how an unsigned real number is represented in fixed-point form in binary.
Representation of negative numbers by Two's Complement.	Describe the use of Two's Complement to perform subtraction. Convert denary number into Two's Complement and vice versa.
Floating point numbers.	Describe the format of floating point numbers including the concept of mantissa and exponent and the need for normalisation.

13.4 Operating Systems

Operating System Classification	
Batch Interactive Real time	Describe the role of Job Control Languages and systems that combine batch and interactive modes.
Multi-programming, multi-user, multi-tasking systems	Describe the principles of multi-programming.
Client-server systems, distributed file systems and network operating systems	Outline the principles of client-server operation. Explain the terms distributed file and network operating systems.
Operating System Concepts	
User-interface	Classify methods of user-interface including command-line, graphical and job-control.
Memory Management	Outline how operating systems manage memory including the concepts of virtual memory and paging, code sharing (re-entrant code), dynamically linked libraries or DLLs.
File Management	Outline how operating systems manage file space. Explain the concept of an addressable block and the use of the file buffer.
I/O Management	Outline the concepts of handlers and drivers and the use of interrupts.
Process / Task / Management	Explain the concept of a process, process states, threads and the need to schedule processes in a multi-programming operating system.

14 A2 Module 5 *Advanced Systems Development*

14.1 Applications and Effects

The applications of computing in a variety of contexts	These could include science, education, manufacturing industry, commercial data processing, publishing, leisure, design, communication, embedded systems, information systems, the Internet artificial intelligence and expert systems. Candidates should: consider the purpose of the application; discuss the application as an information system in the context chosen; examine specific user-interface needs; examine the communication requirements of the application; discuss the extent to which the given system satisfies both organisation's and user's needs; discuss the economic, social, legal and ethical consequences of the application.
Generic Packages	
Database, spreadsheet, word-processing, desktop publishing, presentation packages, expert system shells.	As part of their skills development candidates should have sufficient experience of using a database to understand how a database management system controls access to the data via user views. In addition, they should be aware of how the listed packages facilitate the execution of particular tasks. Candidates should be able to assess the suitability of a given package for a particular task as well as its limitations. Candidates should also appreciate how these packages might be integrated or share common data and be customised by the use of macros.
Social, Economic and Legal Consequences of Computerisation	Discuss examples of software failure such as in safety critical systems, errors in commercial transactions and errors caused by poorly specified systems. Discuss the possible effects from a social, economic and legal point of view.

14.2 Databases

Database Concepts

Three level architecture of a DBMS. External or user schema. Conceptual or logical schema. Internal or storage schema. Program / data independence.	Describe the structure of a Database Management System (DBMS). Distinguish between the use of a database and the use of a Database Management System (DBMS). Consider how a DBMS improves security and eliminates unproductive maintenance.
Concurrent access to data	Discuss how a DBMS overcomes problems that arise with multi-user access.
ODBC (Open Database Connectivity)	Explain the term and consider situations where it is used.
Data Definition Language (DDL)	Explain the terms DDL and DML. Candidates should be familiar with the use of a DDL to define a database.
Data Manipulation Language (DML)	

Database Design and the Relational Model

Entity-relationship modelling. Normalisation techniques	Illustrate the principles of database design using these techniques in the production of normalised tables that control redundant data, studied up to BCNF.

Querying a Database

Structured Query Language (SQL)	Illustrate the use of a Structured Query Language using the constructs Select, From, Where, GroupBy and OrderBy to extract data from several tables of a relational database.
Database Server	Define and explain the operation of a database server.
Object-oriented Databases	Define and explain the need for object-oriented databases. Candidates need to understand that databases may need to store complex data types and their associated methods of access.

14.3 Systems Development

Analysing a System	
Fact finding techniques	Interview, observation, survey, examination of paperwork.
Reporting techniques	Data flow diagrams, Entity Attribute Relationship Modelling (EAR)
Data dictionary	Explain a data dictionary.
Volumetrics	Data volumes Characteristics of users
Designing a System	System flowcharts, prototyping, user interface design.
Testing Strategies for the development of a System	Top down, Bottom up; Black-box testing, White-box testing. Unit testing, Integration testing.
System Implementation	
Conversion	Consider the problems that may arise when converting from the old to the new system.
Parallel, direct, pilot, phased	Describe the four main methods of converting from the old to the new.
System testing Acceptance testing Alpha and beta testing	Define the different types of testing that may be applied to the developed system.
Training	Consider the training needs for the new system.
Installation manual, user manual, operations manual, training manual / documentation.	
Evaluation	Consider the purpose and timing of the evaluation.
Maintaining a System	Explain the need for maintenance. Consider the factors that affect the maintainability of a solution and evaluate a solution for maintainability in terms of the ease with which a program / solution can be corrected if an error in encountered, adapted if its environment changes, or enhanced if customer changes requirements.

14.4 Hardware Devices

Input and output methods	Examine the role of computer devices in relation to both the nature and volume of the data being input and the characteristics of the user. Consider how the application influences the input method. Discuss the choice of output method in relation to applications and user needs, including the issue of whether printed reports, visual display, sound or other outputs are most appropriate. Consider how computers may assist in situations where the user may be unable to utilise conventional methods of input and output. Discuss situations where output may control machinery. Candidates should be able to select appropriate hardware by making an informed choice, rather than by learning a list of devices. Comprehension questions, based on contemporary devices and the principles of their operation and use, would be most suitable for this area of the syllabus.

14.5 Networking

Methods	
Baseband and broadband modes of network operation	Define each method and illustrate where each is appropriate.
Synchronous data transmission Time-division multiplexing	
Circuit switching Packet-switching Datagram virtual circuit	Describe and contrast the operation of these three network types - circuit-switched, packet-switched, ATM.
Asynchronous Transmission Mode (ATM)	
Standard Protocols TCP/IP protocol stack	Explain the concept and need for standard protocols both across a network and linking computers. Describe the layers of the TCP/IP protocol stack.
Sockets	Candidates should be aware that sockets can connect an application to a network protocol, such as TCP/IP.
Local Area Networks	
Types of cable	Twisted pair, baseband coaxial cable, broadband coaxial cable, optical fibre.
Topology Bus Ring Star Switched Ethernet and Hubs	Define the term topology. Describe in general terms the operation of these networks. Compare the advantages and disadvantages of each.
Segment	Define the term and explain why local-area networks based on a bus topology are segmented.
Bridge	Define the term and explain why it is used.

Peer-to-peer networking	Explain what is peer-to-peer networking and compare with server-based networking.
Wide Area Networks	Contrast wide area and local area networks.
Electronic Data Interchange (EDI)	Describe EDI.
Value-Added Network (VAN) providers	Contrast private and public networks.
On-line service providers Internet Service Providers (ISP) Internet	What is meant by an on-line service? Explain why such services are provided.
Connecting to a wide area network leased line ISDN cable modem dial-up line and modem Asymmetric Digital Subscriber Line (ADSL)	Compare the various methods that may be used and consider where it would be appropriate to use each method.
CODEC	Short for Coder/decoder, a device that encodes or decodes a signal e.g. to convert binary signals transmitted on a digital network to analogue signal on an analogue network.
Inter-networking	Explain the meaning of the term inter-networking.
Routers / Gateways	Define these terms and consider where and why they are used. In particular consider how routing is achieved across the Internet and how local area networks are connected to the Internet.
The Internet and its Uses	
World Wide Web (WWW) Internet registries and Internet registrars Client / server model of Internet.	Candidates should be familiar with the structure of the Internet and the facilities that it provides to users.
HTTP protocol Hyperlinks	Candidates should be familiar with elementary syntax and use of hypertext mark-up language.
Web site Web page construction The organisation of Web pages on a Web site	Candidates should have some experience of creating Web pages and be familiar with how Web pages can be organised on a Web site. Candidates should be familiar with the use of forms, the posting of data to a web server application and tables in HTML
FTP	Candidates should be familiar with the use of FTP to transfer files such as Web pages from a local machine to a Web server.

Telnet	Candidates should be familiar with how Telnet can be used to manage a remote Web site or to access a remote machine including retrieving e-mail.
Role of URLs in retrieval of Web documents	
Internet search engines	Candidates should have some experience of using a search engine and understand its purpose.
Web browser Java and applets	Candidates should be aware of how applications may be executed on a Web site and how Java applets allow programs to be executed through browsers.
Active Server Pages (ASP)	Candidates should be aware that ASPs can combine HTML, scripts and components to create dynamic web pages. They will not be expected to be able to produce such a page.
E-mail Usenet Internet Relay Chat (IRC) Videoconferencing On-line shopping and banking	Candidates should be familiar with the use of these facilities, their advantages and disadvantages.
Moral, Ethical, Social and Cultural Issues	Candidates should be made aware of its use and misuse by individuals or groups. The World Wide Web as a force of empowerment.
Security and the Internet	
Firewalls Encryption Digital Signatures and Digital Certificates	Describe and explain the need for these in the context of the Internet and understand the issues that surround these. Candidates should be familiar with the principles of both private and public key encryption.

15 A2 Module 6 *The Practical Project*

Module 6 is assessed in the Project which is designed to test the candidates' understanding of the connections between different areas of computing.

15.1 Systems Development

Analysis

Data Flow Diagrams Entity Relationship data modelling E-R diagrams Object-analysis diagrams	Specify and document the data flow and the processing requirements for a system to the appropriate level and identify possible needs for the development and maintenance of the system. Establish the data requirements and produce a full conceptual data model from these, document any constraints and assumptions. Produce a preliminary data dictionary. Document any requirements for specific mathematical algorithms e.g. calculating interest payments. Object-analysis diagrams cover association diagrams, inheritance diagrams, aggregation diagrams, class definitions of class attributes and operations.

Design

System Flowcharts Algorithm design Object-oriented design Hierarchy charts Structure charts Pseudo-code Relations	Consider and evaluate alternative ways of developing a solution to a problem on the basis of effectiveness, cost and ease of development and maintainability. Specify and document a design that meets the requirements of a real problem in terms of hardware and software, using methods such as system flowcharts, structure charts, hierarchy charts, pseudo-code, relations, appropriate class diagrams (e.g. graphical user interface), object diagrams.
Prototyping	Consider the impact of prototyping on the design and development process.
Human-Computer-Interface (HCI)	Good HCI design: Considers The User – type of use and context – e.g. business or home – User needs/Usability Input/output devices – choice of and appropriateness of Dialogues – to be relevant, simple and clear Colour – use of and colour combinations Icon usage and presentation – 3D effects and depth perception

Provides
- Feedback
- Exits – clearly marked
- On-line help
- Shortcuts
- Helpful error messages

Prevents errors occurring
Minimises the amount the user has to remember

Testing Strategies	Top down, bottom up; Black-box testing. White-box testing. Identify suitable test strategies and select and document suitable test data. Unit testing, Integration testing, System testing, Acceptance testing. Test solution and document the results of testing.
Construction / Implementation	Make use of appropriate software tools and techniques to construct a solution to a problem.
Maintenance	Develop and document a solution for maintainability. For maintainability a solution should be evaluated in terms of the ease with which it can be corrected if an error is encountered, adapted if its environment changes, or enhanced if customer changes requirements.
Evaluation	Evaluate methods and solutions on the basis of effectiveness, usability and maintainability.

Key Skills and Other Issues

16 Key Skills – Teaching, Developing and Providing Opportunities for Generating Evidence

16.1 Introduction

The Key Skills qualification requires candidates to demonstrate levels of achievement in the Key Skills of *Application of Number*, *Communication* and *Information Technology*.

The units for the 'wider' Key Skills of *Improving own Learning*, *Working with Others* and *Problem-Solving* are also available. The acquisition and demonstration of ability in these wider Key Skills is deemed highly desirable for all candidates, but they do not form part of the Key Skills qualification.

GCE A Level Computing (Grades A to E) provides full exemption from IT Key Skill at Level 3. GCE AS Level Computing (Grades A to E) provides exemption from the external test in IT Key Skill at Level 3.

Copies of the Key Skills Units may be downloaded from the QCA web site (www.qca.org.uk/keyskills).

The units for each Key Skill comprise three sections:

A What you need to know.

B What you must do.

C Guidance.

Candidates following a course of study based on this specification for Computing can be offered opportunities to develop and generate evidence of attainment in aspects of all of the Key Skills. Areas of study and learning that can be used to encourage the acquisition and use of Key Skills, and to provide opportunities to generate evidence for Section B of the units, are signposted below. More specific guidance on integrating the delivery of Key Skills in courses based upon this specification is given in the AQA Teachers' Guide.

16.2 Key Skills Opportunities in Computing

This AS and A Level specification in Computing provides opportunities for developing and generating evidence for assessing the Key Skills listed below.

- Communication
- Information Technology

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

The broad and multi-disciplinary nature of Computing that calls upon candidates' abilities to demonstrate the transferability of their knowledge, understanding and skills, make it an ideal vehicle to assist candidates to develop their knowledge and understanding of Key Skills and to produce evidence of their application

The matrices below signpost the opportunities for the acquisition, development and production of evidence for Section B of each of the Key Skills units at *Level 3*, in the teaching and learning modules of this specification. The degree of opportunity in any one module will depend upon a number of centre-specific factors, including teaching strategies and level of resources.

Communication

What you must do:		**Signposting of Opportunities for Generating Evidence in Modules**					
		1	**2**	**3**	**4**	**5**	**6**
C3.1a	Contribute to discussions		✓		✓	✓	✓
C3.1b	Make a presentation			✓	✓	✓	✓
C3.2	Read and synthesise information			✓	✓	✓	✓
C3.3	Write different types of documents			✓	✓	✓	✓

Application of Number

What you must do:		**Signposting of Opportunities for Generating Evidence in Modules**					
		1	**2**	**3**	**4**	**5**	**6**
N3.1	Plan and interpret information from different sources		✓	✓			✓
N3.2	Carry out multi-stage calculations		✓	✓			✓
N3.3	Present findings, explain results and justify choice of methods		✓	✓			✓

Information Technology

What you must do:	Signposting of Opportunities for Generating Evidence in Modules					
	1	2	3	4	5	6
IT3.1 Plan and use different sources to search for and select information		✓	✓			✓
IT3.2 Explore, develop and exchange information and derive new information		✓	✓			✓
IT3.3 Present information including text, numbers and images		✓	✓			✓

Working with Others

What you must do:	Signposting of Opportunities for Generating Evidence in Modules					
	1	2	3	4	5	6
WO3.1 Plan the activity	✓	✓		✓	✓	
WO3.2 Work towards agreed objectives	✓	✓		✓	✓	
WO3.3 Review the activity	✓	✓		✓	✓	

Improving own learning and performance

What you must do:	Signposting of Opportunities for Generating Evidence in Modules					
	1	2	3	4	5	6
LP3.1a Agree and plan targets	✓	✓	✓	✓	✓	✓
LP3.2 Seek feedback and support	✓	✓	✓	✓	✓	✓
LP3.3 Review progress	✓	✓	✓	✓	✓	✓

Problem Solving

What you must do:	Signposting of Opportunities for Generating Evidence in Modules					
	1	2	3	4	5	6
PS3.1 Recognise, explain and describe the problem			✓			✓
PS3.2 Generate and compare different ways of solving problems			✓			✓
PS3.3 Plan and implement options			✓			✓
PS3.4 Agree and review approaches to tackling problems			✓			✓

NB The signposting opportunities recorded in the tables above represent the opportunities to acquire and produce evidence of the Key Skills seen to be achievable through the specification. There may be other opportunities to achieve these and other aspects of Key Skills, but these are dependent on the detailed course of study delivered within centres.

16.3 Key Skills in the Assessment of Computing

The 'main' Key Skills of Communication and Application of Number must contribute to the assessment of Computing. Aspects of Communication and Application of Number are an intrinsic part of Assessment Objectives 1, and 2 and hence will form part of the assessment requirements for all units but more especially the A2 Units. In addition, in any specification of this nature the skill of Problem Solving is an integral part of the practical component.

16.4 Further Guidance

More specific guidance and examples of tasks that can provide evidence of single Key Skills or composite tasks that can provide evidence of more than one Key Skill are given in the AQA Teachers' Guide.

17 Spiritual, Moral, Ethical, Social, Cultural and Other Issues

17.1 Spiritual, Moral, Ethical, Social and Cultural Issues

The study of Computing can contribute to candidates' understanding of spiritual, moral, ethical, social and cultural issues.
The specification provides opportunities for candidates to explore these issues for example:

- in AS Module 2 (11.1) and A2 Module 5 (14.1) candidates are expected to discuss the social, economic, ethical and legal consequence of computerisation;
- in A2 Module 5 (14.5) candidates are asked to consider the moral, ethical, social and cultural issues involved in the use and misuse of the Internet. This should develop in candidates an appreciation of the Internet as a means of global communication which will cut across cultural and religious boundaries.

17.2 European Dimension

AQA has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen papers.
AS Module 2 (11.1) specifies that candidates should be aware of the current legal controls on computerised data and the implications of current legislation which would include the Council of Europe Convention directives.

17.3 Environmental Education

AQA has taken account of the 1988 Resolution of the Council of the European Community and the Report *"Environmental Responsibility: An Agenda for Further and Higher Education"* 1993 in preparing this specification and associated specimen papers.

17.4 Avoidance of Bias

AQA has taken great care in the preparation of this specification and associated specimen papers to avoid bias of any kind.

Practical Components

18 AS Practical Exercise – Module 3 Assessed by the Awarding Body

18.1 Requirements

In preparation for the Practical Exercise it is expected that teachers will introduce and use relevant software as suggested by the Practical Exercise specification, but they should avoid using the Exercise as the sole exemplar in their teaching.

The exercise can be solved by writing a program using a high level language.

In completing the Exercise, candidates will be required to demonstrate, at an appropriate level, at least two of the skills of analysing, designing, implementing, testing and evaluating systems. The specification will include any necessary and relevant material for those sections not required of candidates, so as to make the complete Practical Exercise relevant.

Details of the documentation required from candidates for the Summer 2008 examination are given in Section 19.

For subsequent years, details of this year-specific information will be notified to centres, in print and on the Website, in the Spring Term before the start of the course.

This documentation must be brought into the examination and submitted with the written answer scripts for Unit 3. A Cover Sheet, signed by the candidate and the teacher, authenticating the work of the candidate, must be attached to the documentation (see Appendix B).

Practical work on the Exercise should be done individually. It is intended that this work should not be a group exercise. Candidates must bring to the examination the documentation of the Exercise which they have produced for themselves.

The questions on the Practical Exercise will be based both on the skills prescribed as a requirement of the problem and those which were detailed in the specification. Some of the questions will require candidates to refer to evidence available in the submitted documentation. To gain the full marks available in this situation, the documentation submitted must be organised in such a way that the examiner can find this evidence quickly and easily. No marks are available for documentation alone.

Additional guidance on the content, layout and presentation of the Practical Exercise is contained in Appendix D on page 75.

19 AS Practical Exercise for Summer 2008 Examination *Peter's Petrol Pumps*

19.1 The following Practical Exercise is for the Summer 2008 Examination only

19.2 Background

Petrol stations selling petrol usually show prices and amount of petrol dispensed on each petrol pump and also have a console in the office showing information about each sale from each petrol pump on the garage forecourt.

Each petrol pump shows how much petrol has been sold, the price per litre in pence to one decimal place and the total amount to pay. The console also displays this information for each pump.

Peter owns a small petrol station with **one** petrol pump. Every day Peter needs to know the number of litres of petrol that are sold and the total amount of money taken for the pump.

You have been asked to write a **PROGRAM** to simulate the display on the pump and on the console.

The system you are to develop is simplified and should not include details about taking money from the customers but just assume that the amount displayed is the amount of money received. Also you are **not** required to test for the customer's petrol tank overflowing when the petrol is being dispensed.

19.3 Specification

1. You have been asked to write a program to simulate the display of **one** petrol pump only and the console. The program needs to record the amount of petrol sold in tenths of a litre and the amount to be paid in pounds and pence every time the pump is used.

   The display on the petrol pump uses seven segment LCDs (Liquid Crystal Displays). As part of your programming you will need to write and test a procedure to display a number as a seven segment figure. The console must also display the total amount of money taken but does not need to use an LCD.

XXX.XX	Amount to Pay (£ p)
XX.X	Litres
XXX.X	Pence per litre

   Note to teachers: if a candidate is unable to write a procedure to simulate a seven segment LCD display successfully, a simplified display could be programmed but the candidate may be unable to provide appropriate evidence to answer some questions set in the examination.

2. Peter at the console can:
    - set and change the price per litre in pence
    - zero the amount of petrol dispensed (this will also automatically zero the amount paid)
    - view the total takings and total petrol sold
    - set the total takings and total petrol sold to zero at the beginning of each day.
3. The customer buying petrol can:
    - remove nozzle from holster to indicate they are ready to buy petrol
    - squeeze the nozzle to put petrol in the tank
    - stop squeezing the nozzle to stop putting petrol in the tank
    - replace the nozzle to finish putting petrol in the tank

    Each of the above can be simulated by keystrokes or the use of a button or similar.
4. The petrol pump displays:
    - the current price in pence per litre to 1 decimal place as seven segment LCDs
    - the amount of petrol dispensed at any time as seven segment LCDs showing the number of litres to one decimal place. This display remains after the petrol has been dispensed until zeroed by Peter from the console.
    - the amount to be paid at any time as seven segment LCDs showing the amount in pounds and pence. This display remains after the petrol has been dispensed until the number of litres of petrol dispensed has been zeroed by Peter.

    The pump can dispense between 0.5 and 100 litres in tenths of a litre. The price per litre can be up to 199.9 pence per litre.
5. The console displays:
    - The state of the pump:
        - ready for use (display set to zero customer can start putting petrol in the tank)
        - in use
        - out of use (waiting for Peter to zero the display)
    - the amount of petrol being dispensed by the pump when it is in use, showing the number of litres to one decimal place. This display remains after the petrol has been dispensed until zeroed by Peter.
    - the amount to be paid when the pump is in use in pounds and pence. This display remains after the petrol has been dispensed until the number of litres of petrol dispensed has been zeroed Peter.

When the nozzle is replaced in the holster the amount of petrol dispensed is added to the total amount for that day, and the amount paid is added to the total amount paid from all the sales that day. The pump is flagged as out of use until the number of litres dispensed is zeroed on the pump and the console, it is then set as ready for use by the next customer.

Testing

6. Candidates will need to design and use test data, including boundary values, to test the following:

- the correct working of the seven segment LCDs on the petrol pump
- the correct working of the console display
- a day's operation of the petrol pump that simulates at least **seven** customers buying petrol
- that the displays on the console and the LCDs on the petrol pump match
- resetting the pump after each purchase
- setting the daily totals on the console to zero at the start of the day
- changing the price of a litre of petrol

The console display and the LCDs for the pump can appear on the same screen for testing purposes.

19.4 Requirements of the Practical Exercise

Candidates will need to design and implement an appropriate computing system and provide sufficient documentation to demonstrate the following practical skills:

- Design
- Implement/Test.

The task may be undertaken by writing a program in a chosen high level language.

Candidates are expected to produce brief documentation including some or all of the following, as appropriate.

Design

- Definition of data storage requirements
- User interface design for console and petrol pumps
- Algorithms for
  - pump operation
  - console operation
  - simulating the seven segment LCD display
  - production of daily totals

Implementation/Testing

- Details of test plan with explanation, and evidence of testing having been carried out
- Clearly set out and commented, where appropriate, program listing

This documentation is to be brought to the examination and handed in with the candidate's answer script for Unit 3 (CPT3) at the end of the examination. A Cover Sheet, signed by the teacher and the candidate, authenticating the work of the candidate, must be attached to the documentation (see Appendix B of the specification).

20 A Level Project (Module 6) Centre-Assessed

20.1 Requirements

The Project provides an opportunity to test the candidates' understanding of the connections between the different areas of computing. It allows candidates to demonstrate their knowledge and understanding of the systems development life cycle. The skills to be demonstrated include analysis, design, implementation and evaluation of a substantial computer-based task undertaken over an extended period. The report should summarise the work carried out by the candidate.

Projects should be selected which allow candidates to demonstrate skills of practical application and problem solving, as well as the techniques of documentation and system testing. The system developed by the candidate should allow interaction with the user, storage and manipulation of data and output of results.

Although it is envisaged that the candidate will develop a complete working solution, the project report need only contain carefully selected samples of evidence in order to demonstrate each skill.

21 Guidance on Setting Centre-Assessed Component

21.1 Choice of topic

The Project is centre-assessed and moderated by the Board.

The topic should be within the scope of the specification.

Projects can relate to individual candidates' interests in computing and may embrace applications such as data processing, global communications.

Mathematical computing, graphics, control technology, computer-aided design, simulation and modelling could also be suitable but care must be taken to meet the syllabus requirements. Candidates should investigate a *real* problem associated with a user whose realistic needs should be taken into account when designing the solution.

It is expected that supervisors will give guidance to all candidates on the choice of topic and the level at which it is tackled commensurate with the ability of the candidate and the computing facilities available.

It may be useful to consider the following checklist when advising candidates about their choice of topic.

- Is it a real situation that the candidate can investigate?
- Is there a user whose needs can be investigated and taken into account when designing the solution?

- Does it conform to the specification requirements i.e. will the finished product be a tailored solution which allows interaction between the user and the computer system with input, storage and manipulation of data and output of results?
- Is it of Advanced Level standard?
- Is it within the capability of the candidate to complete in a reasonable time?
- Are the necessary facilities readily available to the candidate?
- Is it a subject the candidate has knowledge of/interest in?

Unless the answer to each of these questions is 'yes', the candidate should be advised to reconsider his/her proposal.
Before work commences on the project, each candidate should be given a Project Log Sheet, which should be completed by the candidate and signed by the supervisor. The Project Log Sheet could provide a useful planning document for candidate and supervisor and could also provide evidence for the assessment of the wider Key Skills. (Centres may photocopy the Project Log Sheet which can be found within Appendix B at the back of this specification).

21.2 Computing Facilities

A major objective of the project is that the candidates should demonstrate that they are capable of solving an information-processing problem using the most appropriate means at their disposal. Where there is a range of computer systems available the candidate should justify, in the Analysis Section of the report, the choice made. In many situations, use of a standard software package that has been customised by the candidate may be more appropriate than a specially written program. However, when a package is used, the report should reflect this. The chosen software package should allow the candidate to create and develop their own code for functions/procedures using a macro language. Candidates should provide full justification for their choice of software. If appropriate, a project may combine the use of specially written programs with the use of standard packages.

21.3 The Project Report

The project is intended to be a practical Computing exercise. The production of a discussion document (even using desk-top publishing or word-processing) is not suitable as a project in itself. A prototype (an initial and simplified solution) may be used as *part* of the project development. However the object of the project is to produce a complete working solution to a problem.
The project report serves to document the skills of the full systems development life cycle.
The report must contain evidence of interaction between the user and the computer system. The analysis section of the report will include an analysis of the users, the application level tasks they need to perform and the computer level skills they are assumed to possess. The alternatives for a user interface should be documented briefly, and the design adopted should be justified. Illustrations of the interface actually implemented should be presented in the implementation section of the report, and evidence that the interface performs satisfactorily should be given in the testing section of the report.

The report must also contain analysis of the application tasks required of the computer system. Alternative approaches should be documented briefly, and the design adopted should be justified. The design section of the report will be concerned mainly with the algorithms, file and data structures selected. Illustrations of the solutions actually implemented should be presented in the implementation section of the report, and evidence that the system carries out the required tasks satisfactorily should be given in the testing section of the report.

The report should relate to the final version of the project. Historical records of the design and implementation are not expected.

Candidates must be selective in what they include in their reports and, although the format is not prescribed, they would be well advised to follow the logical progression of the Assessment Criteria.

Candidates should be discouraged from including unnecessary material. Candidates should practise good project management throughout and should be reminded of the necessity of making regular backup copies of their project files.

21.4 Contents of the Project Report

The skills set out below must be assessed in the project. The project report should contain a contents page and all the pages should be numbered.

Analysis *(12 marks)*

This should involve the candidate in addressing and reporting on a problem associated with a user. Consideration should also be given to the users' realistic needs including the requirement for processing of data. General and specific objectives should be clearly stated. This section should include the identification of possible solutions and the justification for a chosen solution.

The mark awarded should reflect the scope of the project.

Design *(12 marks)*

This section documents the design of the chosen solution, including the user interface and the system functionality. As many tasks may be repeated here it is expected that the candidate provides only a **representative sample** for the report in order to demonstrate their competence in that skill.

Technical Solution *(15 marks)*

Technical competence should be demonstrated in implementing the solution

either: by writing a suitable program or suite of programs;

or: by using a standard package to produce a tailored solution;

or: by a combination of the above.

Evidence for this section may come from copies of code listings in the appendix and/or details of software tailoring included in the systems maintenance section. It is not expected that candidates will supply multiple copies of listings, systems or algorithm design documentation.

Candidates are expected to code some routines in order to demonstrate their technical competence in programming.

Annotation of the code listings should normally utilise the standard commenting features of the implementation software, although hand-annotation of screen designs may be appropriate.

System Testing
(6 marks)

This Section should demonstrate the functioning of the implementation. It should contain clear, concise and comprehensive evidence that the system as a whole operates as required.

Candidates are expected to be selective in what is included in the report. It is inappropriate to include repeated complete printouts of large files just to show a few records successfully updated. Evidence is preferred in the form of actual hard copy output only. Audio or video material may be appropriate for certain specialised projects. Disks should not be included. Illustrations of output are expected to be annotated with comments and cross-referenced to the test plan. Where output has been incorporated into a word-processed document supervisors are expected to authenticate it.

System Maintenance
(6 marks)

This requires a clear overall view of the system and samples of technical explanations of the working system that could be used to correct any errors or extend/enhance or otherwise update the system. Large tracts of documentation from commercial software should not be reproduced. However, reference to such documentation should be provided if appropriate, using a standard referencing convention.

User Manual
(6 marks)

This should contain a brief 'stand alone' document designed for the user, it is not envisaged that this section should be more than four or five pages in length including sample screen displays.
It should be of a level appropriate to the actual user and include realistic operational details appropriate to the actual situation.
Where a package has been used, an explanation must be given of how to apply the package in the candidate's system rather than just how to use the package in general. How to use the underlying package should be given as a reference to the supplier's own documentation, using a standard referencing convention.

Appraisal
(5 marks)

A critical appraisal that matches the original objectives to the final achievement. Suggestions for further development should be included if appropriate. Although it should be the candidate's own appraisal, it may include comment/reports from other users. Where appropriate direct feedback from the identified user is expected and this should be authenticated by the project supervisor.

Quality of Communication
(3 marks)

The report should be an effective means of communication. Relevant information should be organised clearly and logically, in continuous prose, with good use of English grammar, punctuation and spelling.

22 Assessment Criteria

22.1 Criteria

The following skills must be assessed in the project.

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0 to 2	Marks: 3 to 6	Marks: 7 to 9	Marks: 10 to 12
ANALYSIS	Little or no evidence of any analysis. Little or no evidence of investigation of a problem or an inappropriate problem selected, that does not produce a useable computer based solution. No system objectives. Little or no consideration of user needs.	Some analysis but limited in perception and scope. Some evidence of investigation of a problem with limited scope resulting in a standard exercise with few external constraints. Statement of system objectives but lacking in scope and depth. Some evidence of consideration of user requirements.	Evidence of a well-structured analysis. Evidence of a structured investigation into a problem of adequate scope demonstrating consideration of the realistic requirements of a real user. Statement of measurable system objectives.	Evidence of an extensive well structured analysis. Extensive investigation of a demanding open ended problem showing realistic appreciation of system requirements and demonstrating a high level of perception of a real user's needs. Clear and comprehensive set of measurable system objectives.

Expected contents for this section of the report:

Background to and identification of problem;

Identification of the prospective user(s);

Identification of user needs and acceptable limitations;

Data source(s) and destination(s);

Analysis Data Dictionary (from perspective of end user);

DfDs (existing and proposed system);

Objectives for the proposed system;

Realistic appraisal of the feasibility of potential solutions;

Justification of chosen solution.

(use of formal methods e.g. observation, analysis of existing documentation, interviews etc).

If appropriate:

E-R Models;

Identification of Objects and Object analysis diagrams.

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0 to 2	Marks: 3 to 6	Marks: 7 to 9	Marks: 10 to 12
DESIGN	Little evidence of design. A useable system could not be developed from the evidence provided.	Some evidence of design but insufficient detail to produce a useable system without further development of the design. **or** Evidence of a feasible design for a problem of limited scope.	Evidence of a feasible design, clearly documented so that a useable system could be developed for a problem of adequate scope.	Evidence of detailed design, well fitted to a problem of adequate or greater scope, incorporating all the required aspects for the development of a fully working system.

Expected contents for this section of the report:

Overall system design;

Description of modular structure of system;

Definition of data requirements (Design data dictionary- from the viewpoint of programmer) including:

- Description of record structure
- Validation required
- File organisation and processing

or

- Database design including Normalised E-R Model
- Identification of appropriate storage media

Identification of processes & suitable algorithms for data transformation;

Or class definitions (diagrams) and details of object behaviours and methods;

User interface design (HCI) rationale including:

- **Sample** of planned data capture and entry designs (prototype screen dumps may be used but must annotated as the HCI rationale)
- **Sample** of planned valid output designs

Description of measures planned for security and integrity of data;

Description of measures planned for system security;

Overall test strategy.

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0 to 3	Marks: 4 to 7	Marks: 8 to 11	Marks: 12 to 15
TECHNICAL SOLUTION	A project that is a standard exercise demonstrating little evidence of technical competence. **For a program:** Unstructured program that is trivial. **For a package:** As above.	A useable project demonstrating some evidence of a limited range of technical competence or a project that is not fully functional but contains evidence of reasonable technical competence. **For a program:** As above. **For a package:** Utilisation and development of features so that a fully tailored solution is produced i.e. the user does not have to use the raw package interface. Little code written by the candidate.	A working project demonstrating the candidate's technical competence in a range of tasks or a useable project containing evidence of a high range of technical competence. **For a program:** Program showing reasonable structure, e.g. writing of subroutines with parameters, user defined data structures, use of class definitions, server side scripting etc. **For a package:** Fully tailored solution including the writing of appropriate programming language routines to provide a solution fitted to the user requirements.	A robust working project that demonstrates a high standard of technical competence over a range of complex tasks. **For a program:** Well-structured program/suite of programs demonstrating methodologies appropriate to the programming language used. **For a package:** Fully tailored solution including the writing of complex programming language routines to provide a solution fully fitted to the user requirements.

Candidates are expected to code some routines in order to demonstrate their technical competence in programming. Much of the evidence will be contained in the appendices and/or the system maintenance section. All the evidence should be clearly annotated by the candidate demonstrating their understanding of the code they have written.

The type of evidence expected includes the following:

- listings of the program(s);
- listings of macros;
- **samples** of annotated 'design views'[#] showing details of application-generated forms, reports, queries; buttons, cross tabulations etc.;
- any other reported evidence showing how the implementation was achieved.

[#] not evidence from the Design Section but screen dumps showing the structure of these elements as developed

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0	Marks: 1 or 2	Marks: 3 or 4	Marks: 5 or 6
SYSTEM TESTING	No test plan and little evidence of any test output.	A test plan supported by very little annotated hard copy showing test runs; **or** A set of hard copy test runs with some annotation but no test plan to support the evidence. Only testing using typical data.	A test plan showing expected results supported by selected samples of carefully annotated and cross-referenced hard copy of test runs. Incomplete testing using boundary (extreme) and/or erroneous data.	A well-designed test plan showing expected results supported by selected samples of carefully annotated and cross-referenced hard copy showing test runs that prove the reliability and robustness of the candidate's system. All significant aspects thoroughly tested using boundary and erroneous data.

Expected contents for this section of the report:

A test plan that includes

- details of individual tests using a minimal set of test data;
- expected results for typical data;
- expected results for erroneous data;
- expected results boundary (extreme) data;
- samples of annotated hard copy of actual test runs for typical, erroneous and extreme data and samples of annotated hard copy showing the system working (system testing);
- all samples cross-referenced to the test plan.

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0	Marks: 1 or 2	Marks: 3 or 4	Marks: 5 or 6
SYSTEM MAINTENANCE	Little evidence provided to support the system development with no overall system design. **For a program:** No samples of algorithm design. Program listing not self-documenting or with little annotation. **For a package:** No samples of items tailored by the candidate, macro listings not self - documenting or with little annotation. Difficult to distinguish between automatically produced tailoring and the candidate's work.	An overall system design supported by **limited** details of the component parts. **For a program:** Overall system design including limited information about modules/procedures etc. Some samples of algorithm design. Program listing clearly set out with some annotation. **For a package:** List of items developed. Samples of items tailored by the candidate provided in 'design view', code listings with some annotation.	An overall system design supported by **most** details of the component parts. **For a program:** Overall system design including information about modules/ procedures etc. Representative samples of algorithm design. Program listing clearly set out and either self-documenting or clearly annotated. **For a package:** List and clear description of items developed. Samples of items tailored by the candidate provided in 'design view', full code listings, all with clear annotation.	A clearly set out overall system design supported by details of the component parts and underlying structures. **For a program:** Overall system design including information about modules/ procedures etc. Representative samples of algorithm design using an appropriate standard method. Program listings clearly set out and self-documenting. **For a package:** List and clear description of items developed. Details of data structures and links together with samples of items tailored by the candidate provided in 'design view' with clear annotation and full self-documenting code listings.

Expected contents for this section of the report:

System overview;

A sample of the detailed algorithms developed by the candidate;

Procedure and variable lists with descriptions for programs and a list of package items developed with descriptions (if a package is used);

All cross-referenced to listings of program code and **representative samples** of annotated 'design views' showing details of forms, reports, queries; buttons, cross tabulations etc. that have been tailored by the candidate (if a package is used).

There is no requirement to include automatically generated code or details of items generated by using 'wizards'. An acknowledgement that the item has been used is all that is required.

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0	Marks: 1 or 2	Marks: 3 or 4	Marks: 5 or 6
USER MANUAL	Brief information with no evidence provided from candidate's system.	Some information on how to use the candidate's system supported by samples of screen displays.	Well presented documentation incorporating an introduction to system describing functionality together with information on how to use the candidate's system supported by samples of screen displays, but containing some omissions, technicalities and/or obscurities preventing easy unaided use.	Well presented documentation incorporating an introduction to system describing functionality together with information on how to use the candidate's system supported by samples of screen displays and error messages. The manual should be at a level appropriate for the prospective user.

Expected contents for this section of the report, which should read as a self-contained document:

Contents page;

A brief introduction and installation instructions;

Detailed description of how to use **one section** of the system including

- **Samples** of actual screen displays in situ;
- **Samples** of error messages and error recovery procedures.

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0	Marks: 1	Marks: 2 or 3	Marks: 4 or 5
APPRAISAL	None provided or a few inappropriate comments.	Little attempt made to relate achievement to the original objectives and/or shortcomings not identified.	Achievement related to objectives. Analysis of any improvements needed together with indication of how these could be incorporated. Evidence of user feedback.	Achievement clearly and directly related to objectives. Analysis of any improvements needed together with realistic suggestions of how these could be incorporated. **Analysis** of feedback from users.

Expected contents for this section of the report:

Comparison of project performance against objectives;

Possible extensions;

User feedback.

The function of this section is a critical appraisal; therefore it is insufficient for the candidate just to state that their system objectives have been met. They should state how they have been met or if an objective has not been met give the reasons why this was not possible.

User feedback, where present, should be objective and refer to how well the system met their requirements. If the user is using the system then this should be clearly identified by the candidate. Any identified improvements should incorporate planned action arising from analysis of user feedback.

The project supervisor should always authenticate direct feedback from the identified user. Candidates should be actively discouraged from providing simulated feedback.

	Standard exercise with limited scope		Adequate scope → open ended problem	
	1	2	3	4
	Marks: 0	Marks: 1	Marks: 2	Marks: 3
QUALITY OF COMMUNICATION	Very scrappy presentation with little or no attempt at logical layout.	Not well presented either in style or logic but with some attempt at suitable layout.	Clearly and logically presented with some deficiencies in grammar, punctuation and spelling.	Clearly and logically presented. Grammar, punctuation and spelling of an acceptable standard with few and minor errors.

The report should have the following characteristics:

Contents page;

Clear and logical organisation;

Set out in sections identified in the specification;

Continuous page numbering;

Information presented in continuous prose;

Good use of English grammar, punctuation and spelling;

Word-processed with a clear font style and size e.g. Times New Roman 10 pt or 12 pt;

Use of appropriate word-processing techniques e.g. headers and footers, consistent styles for headings, use of tables etc.

22.2 Evidence to Support the Award of Marks

Teachers should keep records of their assessments during the course, in a form which facilitates the complete and accurate submission of the final assessments at the end of the course.
When the assessments are complete, the final marks awarded under each of the assessment criteria must be entered on the Candidate Record Form, with supporting information given in the spaces provided. A specimen Candidate Record Form appears within Appendix B; the exact design may be modified before the operational version is issued.
The Candidate Record Form and Project Log Sheet must be attached to the candidate's work.

23 Supervision and Authentication

23.1 Supervision of Candidates' Work

Candidates' work for assessment must be undertaken under conditions which allow the teacher to supervise the work and enable the work to be authenticated. If it is necessary for some assessed work to be done outside the centre, sufficient work must take place under direct supervision to allow the teacher to authenticate each candidate's whole work with confidence.

23.2 Guidance by the Teacher

The work assessed must be solely that of the candidate concerned. Any assistance given to an individual candidate which is beyond that given to the group as a whole must be recorded on the Project Log Sheet and Candidate Record Form.

23.3 Unfair Practice

At the start of the course, the supervising teacher is responsible for informing candidates of the AQA Regulations concerning malpractice. Candidates must not take part in any unfair practice in the preparation of coursework to be submitted for assessment, and must understand that to present material copied directly from books or other sources without acknowledgement will be regarded as deliberate deception. Centres must report suspected malpractice to AQA. The penalties for malpractice are set out in the AQA Regulations.

23.4 Authentication of Candidate's Work

Both the candidate and the teacher are required to sign declarations on the Candidate Record Form confirming that the work submitted for assessment is the candidate's own. The teacher declares the work was conducted under the specified conditions, and records details of any additional assistance.

24 Standardisation

24.1 Standardising Meetings

Annual standardising meetings will usually be held in the autumn term. Centres entering candidates for the first time must send a representative to the meetings. Attendance is also mandatory in the following cases:

- where there has been a serious misinterpretation of the specification requirements;
- where the nature of coursework tasks set by a centre has been inappropriate;
- where a significant adjustment has been made to a centre's marks in the previous year's examination.

Otherwise attendance is at the discretion of centres. At these meetings support will be provided for centres in the development of appropriate coursework tasks and assessment procedures.

24.2 Internal Standardisation of Marking

The centre is required to standardise the assessments across different teachers and teaching groups to ensure that all candidates at the centre have been judged against the same standards. If two or more teachers are involved in marking a component, one teacher must be designated as responsible for internal standardisation. Common pieces of work must be marked on a trial basis and differences between assessments discussed at a training session in which all teachers involved must participate. The teacher responsible for standardising the marking must ensure that the training includes the use of reference and archive materials such as work from a previous year or examples provided by AQA. The centre is required to send to the moderator the Centre Declaration Sheet (see Appendix B), duly signed, to confirm that the marking of centre-assessed work at the centre has been standardised. If only one teacher has undertaken the marking, that person must sign this form.

25 Administrative Procedures

25.1 Recording Assessments

The candidate's work must be marked according to the assessment criteria set out in Section 22.1. The marks and supporting information must be recorded in accordance with the instructions in Section 22.2.

The completed Candidate Record Form and the Project Log Sheet for each candidate must be attached to the work and made available to AQA on request.

25.2 Submitting Marks and Sample Work for Moderation

The total component mark for each candidate must be submitted to AQA on the mark sheets provided by AQA or via Electronic Data Interchange (EDI). Centres will be informed which candidates' work is required in the samples to be submitted to the moderator.

25.3 Factors Affecting Individual Candidates

Teachers should be able to accommodate the occasional absence of candidates by ensuring that the opportunity is given for them to make up missed assessments.

Special consideration should be requested for candidates whose work has been affected by illness or other exceptional circumstances. Information about the procedure is issued separately.

If work is lost, AQA should be notified immediately of the date of the loss, how it occurred, and who was responsible for the loss. AQA will advise on the procedures to be followed in such cases.

Where special help which goes beyond normal learning support is given, AQA must be informed so that such help can be taken into account when assessment and moderation take place.

Candidates who move from one centre to another during the course sometimes present a problem for a scheme of internal assessment. Possible courses of action depend on the stage at which the move takes place. If the move occurs early in the course the new centre should take responsibility for assessment. If it occurs late in the course it may be possible to accept the assessments made at the previous centre. Centres should contact AQA at the earliest possible stage for advice about appropriate arrangements in individual cases.

25.4 Retaining Evidence and Re-Using Marks

The centre must retain the work of all candidates, with Candidate Record Forms and Project Log Sheets attached, under secure conditions, from the time it is assessed, to allow for the possibility of an enquiry upon result. The work may be returned to candidates after the issue of results provided that no enquiry upon result is to be made which will include re-moderation of the coursework component. If an enquiry upon result is to be made, the work must remain under secure conditions until requested by AQA.

Candidates repeating the examination may carry forward their moderated mark for the coursework component once only and within a 12-month period.

26 Moderation

26.1 Moderation Procedures

Moderation of the coursework is by inspection of a sample of candidates' work, sent by post from the centre to a moderator appointed by AQA. The centre marks must be submitted to AQA and the sample of work must reach the moderator by a specific date in the year in which the qualification is to be awarded.

Following the re-marking of the sample work, the moderator's marks are compared with the centre marks to determine whether any adjustment is needed in order to bring the centre's assessments into line with standards generally. In some cases it may be necessary for the moderator to call for the work of other candidates. In order to meet this possible request, centres must have available the coursework, Candidate Record Forms and Project Log Sheets of every candidate entered for the examination and be prepared to submit it on demand. Mark adjustments will normally preserve the centre's order of merit, but where major discrepancies are found, AQA reserves the right to alter the order of merit.

26.2 Post-Moderation Procedures

On publication of the GCE results, the centre is supplied with details of the final marks for the coursework component.

The candidates' work is returned to the centre after the examination. The centre receives a report giving feedback to the centre on the appropriateness of the tasks set, the accuracy of the assessments made, and the reasons for any adjustments to the marks.

Some candidates' work may be retained by AQA for archive purposes.

Awarding and Reporting

27 Grading, Shelf-Life and Re-Sits

27.1 Qualification Titles	The qualifications based on these specifications have the following titles: AQA Advanced Subsidiary GCE in Computing. AQA Advanced GCE in Computing.
27.2 Grading System	Both the AS and the full A Level qualifications will be graded on a five-grade scale: A, B, C, D and E. Candidates who fail to reach the minimum standard for grade E will be recorded as U (unclassified) and will not receive a qualification certificate. Individual assessment unit results will be certificated.
27.3 Shelf-Life of Unit Results	The shelf-life of individual unit results, prior to the award of the qualification, is limited only by the shelf-life of the specification.
27.4 Assessment Unit Re-Sits	Each assessment unit may be re-sat an unlimited number of times within the shelf life of the specification. The best result will count towards the final award. However, marks for individual units may be counted once only to an AS and/or A level award. Candidates who repeat an award and who do not decline their previous grade must re-sit all units. An AS result can be converted into a full A Level award by taking the A2 examination at any examination series when Computing is available.
27.5 Minimum Requirements	Candidates will be graded on the basis of work submitted for the award of the qualification. Zero marks rather than absent will be recorded where no work for a component has been submitted.
27.6 Awarding and Reporting	This specification complies with the grading, awarding and certification requirements of the current GCSE, GCE, VCE, GNVQ and AEA Code of Practice 2006/7 and will be revised in the light of any subsequent changes for future years.

Appendices

A Grade Descriptions

The following grade descriptions indicate the level of attainment characteristic of the given grade at A Level. They give a general indication of the required learning outcomes at each specific grade. The descriptions should be interpreted in relation to the content outlined in 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 (as in section 6) overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

Grade A Candidates demonstrate:

- good understanding of theoretical concepts;
- appropriate and accurate use of technical lanaguage;
- detailed knowledge of a range of applications;
- informed opinions on effects of computing on society;
- the application of knowledge and understanding to unfamiliar problems;
- good understanding of data types and structures and how to use them;
- effective and appropriate use of a range of software;
- ability to design and produce effective solutions to complex problems;
- a methodical, analytical and critical approach to problem solving;
- the ability to design, operate and justify appropriate testing strategies;
- clear communication of design decisions and solutions to problems;
- effective skills of evaluation.

Grade C Candidates demonstrate:

- understanding of the main theoretical concepts;
- accurate use of technical terms;
- knowledge of a range of applications and their main effects on society;
- the application of knowledge and understanding to familiar problems;
- understanding of data types and structures and their uses;
- ability to use a range of software;
- ability to design and produce solutions to substantial problems;
- a methodical and analytical approach to problem solving;
- the ability to design and operate appropriate testing strategies;
- clear communication of solutions to problems;
- skills of evaluation.

Grade E Candidates demonstrate:

- some relevant knowledge and limited understanding of theoretical concepts;
- use of basic technical terms;
- basic knowledge of computing applications and their effects;
- recognition of hardware and software elements appropriate to a given situation;
- some knowledge of data types and structures;
- basic use of analytical methods to solve straightforward familiar problems;
- some limited skill in justifying or considering alternatives;
- the ability to test solutions in a limited way;
- the ability to produce basic documentation;
- basic evaluative skills.

B

Coursework Record Forms

The Candidate Record Forms have been deleted from this specification because of changed requirements. The latest version of the forms are on the Coursework Administration pages of the Website.

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C Overlaps with other Qualifications

GCE Computing

This specification has many topics in common with the other three GCE specifications in Computing as all incorporate the Subject Criteria for Computing. All three require candidates to study a high level language and learn how to solve problems involving complex data structures and to demonstrate some knowledge of Assembly code programming. Systems software, e.g. operating systems, feature in all three specifications. Networking concepts are also covered but the AQA specification places a greater emphasis on this area in particular, having sections on the Internet, Web page construction, Internet search engines etc. The three GCE Computing specifications have a different approach to the assessment of practical work at AS Level. At A2, all specifications require a project assessing the same skills as required by the Subject Criteria.

GCE ICT

In both Computing and ICT specifications candidates are expected to have a knowledge of the range of computer applications and the social, economic and ethical consequences of current uses, together with legal implications. A knowledge of common software application packages such as word processing, spreadsheets, databases and presentation packages is also required in both subjects as is a basic knowledge of hardware components. The AQA ICT specification does not overlap to any great extent beyond the points mentioned above. The Computing specification concentrates on the technical aspects of computing including programming, advanced database implementation, operating systems, technicalities of hardware operation and networking. The AQA ICT specification places emphasis on the gathering, dissemination, storing and management of information and the ways in which ICT may be used to bring about changes which affect individuals, organisations and society. The ICT practical work does not require programming but is aimed at making candidates competent at analysing, designing, implementing, testing and evaluating solutions using the advanced features of software packages.

AVCE Information and Communication Technology

This specification overlaps in that it covers event-driven programming and networking as well as those topics mentioned in GCE ICT.

D CPT3: Practical Exercise Unit Additional Guidance on Content, Layout and Presentation

Details of the Practical Exercise

The brief for the practical exercise is contained in the specification booklet. Each brief is year-specific and it is vital that centres prepare candidates for the correct practical exercise. The definitive version of the specification for any one year of examination is available on the AQA Website (www.aqa.org.uk).

A printed version of the year-specific brief for CPT3 will also be distributed to centres by means of the AQA *Examinations Update* each year.

Method of Solution

The candidate is free to decide which would be the most appropriate method of solution taking into account their own abilities and experience and the nature of the problem. From AQA's point of view, no one method is preferred, **unless otherwise stated in the year-specific brief.**

The Complexity of the Practical Exercise

AQA is aware that candidates for CPT3 may have only been following the course for a few months. This exercise is testing the ability and understanding of candidates at the end of the first year of a two-year course. However, centres must be aware that class solutions are considered cheating. Any specific help given by a supervising teacher to a particular candidate or group of candidates should be noted on the Practical Exercise Cover Sheet of each candidate concerned.

Candidates may also find it helpful to be reminded that humans can form part of a system and human interaction may solve a particular difficulty encountered along the way.

The Organisation of the Documentation

As can be seen from the specimen practical exercise and the unit papers for Summer 2001, 2002, 2003, 2004, 2005 and 2006 candidates will be asked to indicate where in their documentation they have provided evidence that they have covered certain points as required by the year-specific specification brief.

Documentation **must** therefore be succinct and clearly laid out. The documentation requested is limited to ensure that about 25-30 pages is a maximum and AQA would expect less. (See the table on the following page.) Candidates will not have time to search their own documentation for the relevant reference if it is very much more extensive. It should therefore be as brief as possible whilst including evidence as listed above.

The use of a body text point size of more than 12 simply increases the number of sheets required, and, ultimately, adds to postal costs.

The first page should be the Practical Exercise Cover Sheet which **must** be completed and signed by the candidate and the teacher.

Pages **must** be numbered and in a position that is clearly visible when the documentation pages are tagged together (i.e. in the bottom right-hand corner of each page), and a contents page added for the benefit of candidates. The purpose of the numbering is to facilitate the candidate and the examiner finding the required evidence quickly and referencing it accurately. Page numbering should therefore be **sequential from start to end**, not subdivided into sections. It should be noted that if the pages are not numbered, examiners will not have time to search through the documentation for the appropriate references.

The table below indicates how documentation for the PostQuick Parcels Practical exercise (see Summer 2001) might have been organised.
The columns at the right indicate the number of pages that might be required for the various methods of solution. This example should be taken as indicative of the size and layout of the practical documentation irrespective of the year of the examination.
Not all year-specific briefs for CPT3 allow for a solution by spreadsheet (SS) it should be noted. (DB = database solution)

			If solution is:		
	Requirement of Brief	**Possible evidence**	**Coded**	**SS**	**DB**
		Contents Page	1	1	1
1	Defining data requirements	Field definitions including data type and format where relevant; where extra fields have been included, these should be justified.	1	2	3
2	Considering the design of the user interface	Screen dump of data entry form, hard copy of reports.	3	3	3
3	Considering methods of data entry including validation	Annotated section of program listing showing validation rules, printout of worksheet in formula view, table definition showing some validation rules, plus a description of all rules used. (See 4 below.)			
4	Carefully planning record structure, file organisation and processing	Record definitions, with key fields specified, e.g. statements in an annotated program listing, written record description if using a spreadsheet, or table definition in a database. Description of file organisation if relevant. Annotated program listing, printout of worksheets in formula view, printout /screen dump showing expressions in a database. N.B. Screen dumps showing only results are insufficient evidence that formulae have been used.	2 10	2 4	2 4
5	Considering requirements for security and integrity	Description of proposals for **appropriate** security measures.	1	1	1
6	Considering the overall system design	E-R diagrams and Data Flow diagrams, structure/hierarchy charts.	2	2	2
7	Hard copy output to prove correct working of system	2 and 3 above, together with a completed test plan plus evidence that **some** of this testing did take place, and **some** invalid data was rejected. If test data values are specified in the brief, they should be used. N.B. Screen dumps of an error message dialogue box are insufficient unless superimposed on actual testing, with test data visible.	3	3	3
8	Hard copy of solution	Covered in 4 above.			
		TOTAL PAGES	23	18	19

Documentation should cover only the points specified in the brief. There is nothing to be gained by the candidates including more than these points in their documentation.
If candidates use the CPT3 practical exercise as a practice for their A2 CPT6 project for the following year, they should **not** include all the documentation they have produced. Instead, candidates should extract only the required documentation for this exercise as appropriate.

Answering the Examination Questions

Candidates should answer the CPT3 unit questions fully in the spaces provided in the question and answer booklet. They should read each question carefully, as many will be asking for 'how' or 'why' rather than the 'what' that is likely to be recorded in the documentation. This is to enable candidates to demonstrate that they understand their own solution.

Candidates **must** indicate clearly in their documentation the exact place on the page(s) that they want the examiner to consider as well as referencing the page on the script.

Failure to Bring Documentation into the Examination

A candidate **must** hand in his/her documentation with the Unit 3 question paper. Failure to do so will mean that the examiner will have no evidence that the candidate has completed the Practical Exercise. The examiner therefore will be unable to award those marks which are directly dependent on that evidence.

It is suggested that the teacher makes a photocopy of the Practical Exercise documentation once the candidate has completed it. The photocopy should then be given to the candidate for revision purposes. The supervising teacher can then authenticate the original and give it to the candidate as he/she enters the examination room. It can then be used and referenced by the candidate during the exam and handed in with the question paper at the end of the examination.

Linking the Practical Exercise and the Examination Paper

The question paper will have a hole at the top left-hand corner, so the documentation and the Practical Exercise Cover Sheet should be similarly punched and attached to the candidate's script with a treasury tag. Please include the candidate's name and number and the centre number in the footer of the documentation.
Please simply tag the documentation and attach it to the question paper. Do NOT spirally bind it or place it in plastic sleeves because of the bulk created.
Supervising teachers and candidates are reminded, however, that questions will be based on both evidence from the candidate's report on the Practical Exercise and knowledge, skills and understanding acquired from studying Modules 1, 2 and 3.

Re-taking CPT3

The usual rules regarding re-taking/re-sitting AS/A2 units apply. However, centres should be aware that CPT3 is **not available as part of the January AS examination series**.

If a candidate wishes to re-take CPT3, centres should also note that the summer examination will be based on **the new year-specific brief** for that particular summer's examination.
It is essential therefore that the candidate's report on the Practical Exercise is based on that examination's specification brief and thus this will involve the candidate in new preparatory work.