

# **Standard Grade**

## **Arrangements in COMPUTING**

**Foundation, General and  
Credit Levels  
in and after 2005**

**Draft Arrangements  
for Consultation**

**Scottish Qualifications Authority**

**September 2002**

## INTRODUCTION

Arrangements in Computing Studies on the Standard Grade of the Scottish Certificate of Education were issued to presenting authorities and centres in January 1986 and an examination based on these was introduced in 1988.

In the light of the Report of the Standard Grade Review of Assessment Group (SGROAG): "Assessment in Standard Grade Courses: Proposals for Simplification", a Short Life Working Group on Computing Studies subsequently was established and Revised Arrangements in Computing Studies were issued in September 1987. Examinations at Foundation, General, and Credit Levels based on the Revised Arrangements were offered from 1989. The Revised Arrangements recognised the pace of change in the field of computing and it was envisaged that "...the syllabus and content outline will be reviewed at regular intervals".

The introduction of Higher Grade Computing Studies, together with the need to take account of the expanding body of knowledge and of new computer hardware and software developments, led to the establishment early in 1990 of a Joint Working Group (JWG), whose remit was to review the Standard Grade Revised Arrangements.

With the assistance of the JWG, the Scottish Examination Board's Computing Studies Panel modified the original proposals in the light of comments received and the Amended Arrangements were offered from 1994.

The Amended Arrangements in Computing Studies with a Revision of Expanded Content Detail in 1996 are still the basis of Standard Grade courses but the content is now seriously out of date in the rapidly changing world of computing.

The Review leading to these Draft Arrangements has not only looked to update content but also to review the current arrangements for Coursework, External Examinations and Grading. The Review has also taken cognisance of the introduction of National Qualifications courses in Computing Studies, Computing and Information Systems and the National Qualifications Review begun in 2002.

The course title has been changed from Computing Studies to Computing.

The Findings and Recommendations of the Review have been published for comment and these Draft Arrangements are now published for comment.

The intention is to publish Final Arrangements by the end of 2002 for implementation in courses starting in August 2003 and with the first examinations in May 2005.

# 1 RATIONALE

A view widely held by parents, pupils and employers is that young people should know about and be able to use computers since these and related technologies now play an increasingly important part in economic, social and political life.

A rationale for the study of computing includes the following perspectives:

- many young people have an interest in the ways in which computers operate, how hardware and software interact and the various applications of computers;
- young people should have an understanding of the nature and social purpose of computers;
- the study of computers and their uses can be a means of translating educational aims concerning the skills of problem solving into a practical reality to which young people can relate;
- the study of computing can contribute considerably to the general cognitive development of young people and enhance their self-esteem;
- knowledge of computers and their uses gives advantages for future employment and life long learning.

The Standard Grade Computing course reflects all of these perspectives. It is considered that a general, broad-based approach to computing is appropriate to the S3 and S4 stages of education. The Computing syllabus is seen as a vehicle for engaging candidates in problem-solving activities in a variety of contexts and providing them with practical experience in areas where computers are used.

The syllabus is intended to capture and heighten interest and offer a stimulating and systematic study of computers and their uses. The syllabus also provides a suitable basis for further study of the subject and the opportunity to develop the attitudes necessary for responding to the challenges of an increasingly more technological society.

## **2 AIMS, OBJECTIVES AND ASSESSABLE ELEMENTS**

### **2.1 Aims**

The Standard Grade Computing syllabus aims to develop:

- knowledge and understanding of the uses of computers, how they operate, and their effect on the individual and society;
- the ability to apply knowledge and understanding of computing facts in order to find solutions to problems;
- practical abilities in the use of computers and computer software in order to solve practical problems.

In addition, it aims to provide a suitable basis for further study of the subject.

### **2.2 Objectives**

As a result of pursuing the above aims in a computing environment, candidates should be able to demonstrate the ability to:

- recall, describe and explain computing facts and concepts;
- analyse, outline, refine and discuss approaches to finding solutions to problems;
- obtain relevant information and use computer hardware and software in implementing practical solutions to problems;
- identify and rectify errors in practical solutions to problems;
- discuss progress, assess adequacy, consider implications and suggest improvements to the solutions of problems.

### **2.3 Assessable Elements**

The abilities identified by the above objectives are grouped into two assessable elements, namely

Knowledge and Problem Solving  
and  
Practical Abilities.

These elements form the basis for assessing and profiling performance. The level of performance expected of candidates with regard to the abilities within Knowledge and Problem Solving and Practical Abilities is described by the Grade Related Criteria in section 7.

### **3 SYLLABUS - OUTLINE**

#### **3 1 Time Allocation**

In devising the syllabus, a teaching time of 160 hours for the course has been presumed. Time allocations for each syllabus section are indicated below. These times are offered for guidance only and are not prescriptive. The suggested time allocation allows 10 hours for use by the teacher in any section of the syllabus requiring more attention.

#### **3 2 Broad Areas of Content**

The syllabus focuses on three broad areas:

Computer Applications;  
Computer Systems;  
Computer Programming.

The main aspects and detailed content associated with these are specified below. Learning and teaching approaches, and the particular resources to be used, are not prescribed. It is necessary, however, that candidates are provided with learning experiences which will enable them to develop their knowledge and understanding of computing, their problem-solving skills, and a variety of practical abilities. To this end, candidates should spend a significant amount of time undertaking practical work.

The broad areas of content are described in sections 3 2 1 to 3 2 3 below. Detailed Content of these broad areas is detailed in section 4. This Detailed Content will be reviewed every three years.

##### **3 2 1 Computer Applications (70 hours)**

Four areas will be studied:

General Purpose Packages (40 hours)

Communications (10 hours)

Commercial Data Processing (10 hours)

Industrial Applications (10 hours).

Detailed content for the above areas are given in sections 4 1 3 to 4 1 6. The detailed content will be used as the source for questions set in external examination papers.

### 3 2 2 Computer Systems (20 hours)

The main aspects associated with the content of this broad area are:

- Hardware;
- Low level machine;
- Systems software;
- Operating systems.

Detailed content associated with each of these main aspects is provided in section 4 2. The detailed content will be used as the source for questions set in external examination papers.

### 3 2 3 Computer Programming (35 hours)

Programming is concerned with the development of the practical abilities of problem analysis and design of solutions, practical implementation (which includes coding) and evaluation. The main aspects associated with Programming are given in the General Programming Specification in section 4 3 3.

Computer programming will be undertaken in an environment of the centre's choice. Because of the range of environments that may be used, programming will be entirely internally assessed through Project work.

### 3 3 Project Work (25 hours)

Throughout their study of the broad areas of content, candidates are also required to undertake Project work. Project work offers structured learning experiences in which candidates can work at their own pace, creating and following their individual work plans. All candidates will be required to carry out at least two Projects. Candidates' Project work will be used as evidence of attainment in Practical Abilities. The detailed arrangements for undertaking Project work are described in section 5.

## 4 SYLLABUS - DETAILED CONTENT

In the detailed content, the column headed F/G/C specifies the content for Foundation Level; the two columns headed F/G/C and G/C specify the content associated with General Level; and the three columns headed F/G/C, G/C and C specify the content associated with Credit Level.

### 4 1 Computer Applications (70 hours)

This section expands upon the information provided in paragraph 3 2 1 above and on the overviews and practical work or case studies associated with each of the areas within Computer Applications. The overviews and practical work or case studies are intended to give pupils a broad and balanced experience of applications of computer use in a wide variety of situations. The selection of hardware and software to support the areas of study will be at the discretion of the individual centre.

- 4 1 1 Overviews The overviews for each of the areas within Computer Applications detail the content which candidates need to know and understand and be able to use in solving problems.
- 4 1 2 Practical Work or Case Studies

Practical work or a case study is intended to reinforce and expand on some or all of the main aspects described in the associated overview. The practical work will involve the study of specific applications, such as using a desk top publishing package while a case study will involve the study of the use of computers in a specific context, such as databases in a travel agency.

The choice of practical work or case study for each of the four areas - General Purpose Packages, Communications, Commercial Data Processing and Industrial Applications - is the responsibility of the presenting centre and therefore allows for teachers' specialisms or consideration of local interests. Some suggestions for practical work or case studies are given in paragraphs 4 1 3 to 4 1 6.

Practical work and case studies will not be assessed externally. Practical work will be used as the basis for the Non-programming Project.

### 4 1 3 General Purpose Packages (40 hours)

This area considers how computers can be used to input, process, store and transfer information and how applications packages can be seen as tools with problem solving applications. The overview deals in general terms with the main aspects of General Purpose Packages, which should be studied with reference to a broad range of applications, eg electronic mail and on-line library systems.

In addition, the overview specifies the main aspects, word processing, database, spreadsheet, graphics, desk top publishing, presentation and multimedia and web page creation. Study of the main aspects of General Purpose Packages, together with the associated practical work with these classes of package, is expected to require around 40 hours teaching time.

The use of General Purpose Packages affords opportunities for the development of practical abilities. It is recognised, however, that the level of difficulty involved in the practical implementation of an application package is related to the particular hardware and software that is used. It will be for presenting centres to decide which packages will be used and what features of the selected package are appropriate to the development of practical abilities at Foundation, General and Credit Levels.

At present, word processing, desk top publishing and web page creation software have many common elements and documents produced by one package can be imported and published in another. Rather than devise tasks for a particular class of software it would be more appropriate to devise tasks that could be implemented in a number of different classes of software and to consider what the most appropriate software would be as the first stage in the task.

This will allow centres to implement solutions to general document production problems using available software. Similarly presentation software will allow appreciation of the elements of multimedia without centres necessarily having access to multimedia specific software.

Possible practical work:

- Word processing
- Spreadsheet
- Database
- Graphics
- Desk Top Publishing
- Presentation and Multimedia software
- Web page creation

GENERAL PURPOSE PACKAGES - DETAILED CONTENT			
MAIN ASPECT	F/G/C	G/C	C
NEED	storage, retrieval and communication of large quantities of information.	accurate, complete and up-to-date information.	flow of information between and within organisations.
HARDWARE AND SOFTWARE	applications packages; integrated package; basic hardware for general purpose packages; desktop computer; laptop computer; palmtop computer.	printer quality - dpi, speed, colour.	
STORAGE	manual, electronic; types of data - numbers, text, graphics; need for backup.		order of magnitude of storage capacity.
HUMAN COMPUTER INTERFACE (HCI)	menu driven; command driven; user friendliness; WIMP environment - Window, Icon, Mouse/Menu, Pull-down Menu/Pointer.	on-line help, on-line tutorial; Graphical User Interface.	template; wizard.
SOFTWARE INTEGRATION	integrated package links between tasks; common HCI	ease of transfer of data.	static/dynamic data linkage  package integration between separate packages.
SELECTION OF PACKAGES	main purpose of each package (eg word processing for production of text).	potential of packages to fulfil more than one function (eg drawing graphs using spreadsheets).	selection of most appropriate package or packages on the basis of hardware and software availability and the nature of the task.
DATA TYPES	text; number; graphic.	audio; photographic.	animation; video.
IMPLICATIONS			
- SOCIAL	job types and careers; retraining; mail shots.	effects on employment and working conditions; increased paper.	
- SECURITY AND PRIVACY	right of access to personal data; need to check accuracy; precautions against data loss.	exceptions to right of access;  control of access (eg passwords); unauthorised access to data (eg hacking).	data protection principles; data subject, data user; Computer Misuse Act and other legislation.
- ECONOMIC	initial costs.	replacement costs; running costs.	staff costs.

GENERAL PURPOSE PACKAGES - DETAILED CONTENT (continued)

MAIN ASPECT	F/G/C	G/C	C
ADVANTAGES	speed and accuracy of processing; ease of amendment.	increased productivity layout flexibility.	availability of information.
COMMON FEATURES OF MOST GENERAL PURPOSE PACKAGES	run/open application; new; open/load file; package; save file; print file; insert/amend/delete; change text appearance.	print part of file/document; copy/move.	alter HCI parameters; header, footer;  printer drivers.

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GENERAL PURPOSE PACKAGES - DETAILED CONTENT (continued)			
MAIN ASPECT	F/G/C	G/C	C
WORD PROCESSING	enter text; word-wrap; alter line length; alter text alignment; alter text style.	standard paragraph; search and replace; spelling check; tabulation; alter page length.	table; standard letter and mail merge; template; scan text via OCR.
SPREADSHEET	rows/columns/cells; values; text; simple formulae (eg +-*/, SUM(.)); calculation - automatic and manual;  simple charting.	insert row; insert column;  complex formulae; alter column width; replicate; alter cell format and attributes (eg number of decimal places).	formulae involving conditions (IF(..));  relative reference; absolute reference; cell protection;  fully labelled charting.
DATABASE	add record; create fields;  search on one field;  sort on one field;  information system on CD- ROM.	alter record format;  search on more than one field;  complex search for information on CD-ROM	computed field; alter screen input format; alter output format;  use of keywords; sort on more than one field.
GRAPHICS	draw graphic; enter text; select tool.	alter tool attributes (eg line width); scale graphic; rotate graphic.	scan and edit graphic.
DESK TOP PUBLISHING	wizard or template; enter text; add clip art.	import graphic; scale graphic.	change layout; import text; crop graphic.
PRESENTATION AND MULTIMEDIA	wizard or template; enter text; add graphic. simple linkage of slides or screens.	add audio; assemble elements of presentation.	capture audio; capture image; add video; complex linkage of slides or screens.
WEB PAGE CREATION	wizard or template; enter text; add graphic; simple linkage.	add audio; add hotspots.	add video; add table; complex hyperlinks.

4 1 4 Communications (10 hours)

A study of electronic communication, networks and the Internet provides the necessary perspective that computers are not used in isolation but that data is shared and exchanged over a large number of computers.

Possible practical work and case studies:

electronic mail  
the Internet  
school administration network

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COMMUNICATIONS - DETAILED CONTENT

MAIN ASPECT	F/G/C	G/C	C
COMMUNICATIONS	electronic communication; electronic mail;  networks; sharing data and peripherals;  Internet, information available, services, browser; Internet ready computer; teletext; facsimile; on-line, off-line.	local area network; wide area network; reliability of data link; benefits of networks;  search engine with simple search.	email provider; text messaging;  multi-access; network interface card; client and server; features of network operating system;  Internet Service Provider; search engine with complex search; software available - freeware, shareware, commercial; mobile Internet technologies; video conferencing.

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#### 4 1 5 Commercial Data Processing (10 hours)

The study of Commercial Data Processing gives an overview of large scale data processing and the main stages of the data processing cycle involving both batch and interactive processing. The main aspects indicated below should be illustrated by appropriate references to a range of applications, eg e-commerce, on-line banking, mail order, payroll and stock control.

Possible case studies:

- Banking
- Stock Control
- Airline Reservations
- Stock Exchange
- Accounting Applications

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COMMERCIAL DATA PROCESSING - DETAILED CONTENT			
MAIN ASPECT	F/G/C	G/C	C
NEED	volume of documents; speed of processing; speed of access; repetitive tasks.		management information.
DATA PROCESSING CYCLE	data collection;  data preparation, input, processing and storage;  output.	difference between data and information.	
DATA COLLECTION, PREPARATION AND INPUT	bar codes; magnetic stripes.	key to disc; direct data entry; turnaround document.  magnetic ink character recognition (MICR); check digit; types of check (eg length, range, reliability).	remote data entry; mark sense cards; smart cards.  optical character recognition (OCR); validation; verification.
PROCESSING AND STORAGE	data, field, record, file; update; backup.	batch processing; interactive processing; master file; transaction file.	sequential access; random/direct access; file ancestry; multi-user databases..
OUTPUT	paper, screen, pre-printed stationery.		file.
HARDWARE AND SOFTWARE	basic hardware: - mainframe computer system - terminals.		remote terminals.
IMPLICATIONS - SOCIAL  - TECHNICAL  - ECONOMIC  - SECURITY AND PRIVACY	effects on business.  e-commerce; on-line banking;  initial costs; mass market.  accuracy of information; privacy.	job types and careers - programmer - systems analyst - engineer - computer operator - data preparation operator.  electronic funds transfer (EFT); point of sale (POS);  running costs.  security; sale of customer lists.	computer crime, fraud.        current legislation.
ADVANTAGES	comparison with manual system.	maintaining contact with and information about large number of customers.	single entry multiple use.

#### 4 1 6 Industrial Applications (10 hours)

The study of Automated Systems provides an overview of the use of computers in control, design and simulation. In control applications, computers send information to, and receive information from, other devices in the form of electrical signals. The response speed of the system is often a critical factor in the development of such applications. The combination of flexible design and machine control lies at the heart of Computer Aided Design (CAD) and Computer Aided Manufacture (CAM). The whole field of simulation allows representation of situations that would otherwise be too hazardous or lengthy.

Possible case studies:

Robotics  
CAD/CAM  
Industrial Process Control  
Simulations

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INDUSTRIAL APPLICATIONS - DETAILED CONTENT			
MAIN ASPECT	F/G/C	G/C	C
NEED	speed; hazardous environment; repetitive tasks.	efficiency; accuracy.	adaptability.
HARDWARE AND SOFTWARE	interface;  sensors; feedback; robots: - anatomy - motor - programmable - stationary/mobile; CAD/CAM; CNC; simulation.	analogue I/O;  guides - magnetic and light; open and closed loops;  high level instructions;  real-time processing.	A to D and D to A converters;  end effector;  control language; degrees of freedom; digitiser; ROM software.
HUMAN COMPUTER INTERFACE	interaction.		
IMPLICATIONS - SOCIAL  - TECHNICAL  - ECONOMIC	retraining.	employment - changes in nature of job; - increased leisure time.  industrial automation; safety precautions.  high initial cost; long term savings	design of workplace; factory of the future; need for systems analysis.  capital, labour intensive; effects on productivity.

## **4 2 Computer Systems (20 hours)**

This broad area deals with the main aspects of hardware, low level machine, systems software and operating systems. Content may be delivered in the context of particular computer applications or treated as a distinct topic. The separate identification of content in the Arrangements is merely for convenience of definition and does not imply a preference for a particular teaching approach.

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COMPUTER SYSTEMS - DETAILED CONTENT			
MAIN ASPECT	F/G/C	G/C	C
SYSTEMS SOFTWARE	purpose of high level languages; need for translation.	common features of high level languages	special purpose languages; types of translator: - compiler - interpreter - assembler - relative advantages; portability of software.
OPERATING SYSTEMS	operating system as a program;  directory.	standard functions of an operating system;  batch system; interactive system; real-time systems;  types of file: data program.	specialised functions of operating systems: multi-programming multi-access resource allocation;  interactive systems with background job capability;  hierarchical filing system; sequential and random/direct access to data.
LOW LEVEL MACHINE	stored program; bit, byte, kilobyte (K), megabyte (Mb), gigabyte (Gb); main memory size;  Input, Process, Output (IPO); Processor.	concept of machine code;  representation of number, text, graphics;  concept of character set.	word;  concept of addressability; representation of non-negative integers; floating point representation of large numbers.  control unit; Arithmetic/Logic Unit (ALU).
HARDWARE	microprocessor; chip; main store/memory; ROM and RAM; backing store;  current input devices; current output devices; current backing storage devices.	storage location.  current input devices; current output devices; current backing storage devices.	effect of changes in technology;  capacity of backing store; concept of non-magnetic storage; sequential and random/direct access devices.  current input devices; current output devices; current backing storage devices.

COMPUTER SYSTEMS - DETAILED CONTENT (continued)

MAIN ASPECT	F/G/C	G/C	C
<b>input devices</b> (Computer Systems)	mouse; trackball, trackpad; graphics tablet; touch sensitive screen; keyboard.	scanner; digital camera; digital video camera; webcam; voice recognition; handwriting recognition; microphone.	specialised input devices for: - disabled users - virtual reality; use of a variety of input devices for multimedia.
<b>output devices</b> (Computer Systems)	printer: - laser - inkjet; plotter; monitor.	Liquid Crystal Display (LCD); loudspeakers.	specialised output devices for: - disabled users - virtual reality; use of variety of output devices for multimedia; sound card; graphics card.
<b>backing store</b> (Computer Systems)	magnetic tape; floppy disc; hard disc; CD-ROM; DVD.	CDR/CD RW.	backing storage requirements for multimedia.

## **4 4 Computer Programming (35 hours)**

### **4 3 1 Introduction**

The practical abilities, which are to be developed through programming activity, are problem analysis and design of solutions, practical implementation and evaluation. The detailed content associated with programming is specified in paragraph 4 3 3.

### **4 3 2 Programming Environment**

There is no restriction on the software environment to be used for programming activity. However, the chosen environment must enable broad coverage of the main aspects and content given in the general programming specification in paragraph 4 3 3.

Programming environments may involve procedural languages (such as COMAL and Pascal), declarative languages (such as PROLOG), event driven languages (such as Visual Basic) and the use of application packages with high functional capability (such as certain spreadsheet packages), and centres may choose to use a variety of programming environments throughout the course.

Centres will decide which features of their chosen environment will be used by candidates aiming at presentation at particular Levels. Exemplar specifications for a procedural, a declarative and an event driven language, based on the general programming specification, are given in Appendices 1(a) to 1(c). Centres are free to use these exemplars, to amend them, or to devise their own programming specification.

It is to be noted that in these exemplars, some details of the content do not match precisely the general programming specification. This is inevitable, given differences between programming environments and is acceptable for the purposes of assessment for certification as long as there is broad compatibility.

### **4 3 3 Programming a Solution**

The following general programming specification identifies the main aspects that should be covered in programming and indicates the detailed content that should normally be covered at Foundation, General and Credit Levels. This detailed content is exemplified in Appendices 1(a) to 1(c).

GENERAL PROGRAMMING SPECIFICATION			
MAIN ASPECT	F/G/C	G/C	C
REPRESENTATION OF SOLUTION TO PROBLEM	one simple representation (eg structure chart).		use a variety of representations (eg pseudocode, structure chart).
PROGRAM ENTRY	enter; edit; list/print out current version.		
SEQUENCE	significance (if any) of the order of program instructions.		
MODULARITY	sensible arrangement of blocks of code.		
SIMPLE DATA TYPES	numeric; text.		
STRUCTURED DATA TYPES			one-dimensional arrays.
DATA INPUT AND OUTPUT	single item.	multiple items.	
STATEMENTS	assignment of constants; assignment of expressions.	assignment of incremental expressions.	
EXPRESSIONS	simple, commonly used keywords and operators (eg arithmetic operators).	commonly used pre-defined functions; comparison operators.	logical operators.
REPETITION	fixed loop.	control variable used in loop; nested loops.	conditional loops.
SELECTION		simple condition.	complex condition.
IDENTIFY AND RECTIFY ERRORS	syntax, system and logical errors.		
TESTING	use supplied test data.	use own test data.	supply full set of test data.
READABILITY	use meaningful variable names; provide internal commentary.		
USER INTERFACE	screen layout.	prompts to user.	input validation.

## **5 PROJECT WORK (25 hours)**

- 5 1 Candidates respond well to the challenge of solving a problem of appropriate difficulty or carrying out a suitable investigation and thereafter preparing a report. Project work offers the satisfaction of completing a task using a specification that has been accepted, interpreted and developed by the individual. Project work also offers structured learning experiences in which candidates can work at their own pace, create and follow their individual work plans and have the opportunity to decide on priorities as well as outcomes.
- 5 1 1 Project Work provides an appropriate vehicle for the internal assessment of Practical Abilities. The Project specifications and marking schemes issued and the moderation arrangements operated by the Board provide a framework within which comparability and standards can be assured. Projects will be specified by SQA for all Levels.
- 5 1 2 For each candidate, TWO Projects will be used to determine the grade for Practical Abilities. One of these Projects will be a Non-programming Project and the other a Programming Project.
- 5 1 3 SQA will issue a range of Project specifications from which a choice is to be made. Each Project specification will be accompanied by a confidential marking scheme detailing how the Project is to be assessed. The marking scheme will indicate the Level or Levels to which the Project applies, and hence which grades can be achieved. The marking scheme will indicate the cut-off scores associated with the grades available for a particular Project. The Project specifications and marking schemes should not be seen as inviolable: if necessary, they can be amended by the teacher to suit local circumstances with assessable tasks being added or deleted and corresponding changes made to the marking scheme.
- 5 1 4 Projects will be designed to test performance at one, or more than one, Level. For Projects assessing performance at Credit and General Levels, it will be possible for candidates to achieve a “near-miss” grade. Thus candidates may achieve a grade 3 award from a Credit Level Project and a grade 5 award from a General Level Project.
- 5 1 5 It is recognised that candidates aiming at Foundation Level presentation are likely to respond better to short Projects. Consequently, Projects assessing achievement of the Foundation Level should be able to be completed in 6-8 hours. Conversely, candidates at Credit Level are likely to derive considerable benefit from longer Projects. Projects assessing the Credit Level should normally be completed in 10-12 hours. General Level Projects should require 8-10 hours for completion.

5 1 6 It is intended that all candidates, whatever their level of ability, will spend approximately 25 hours of class time on Project work. The balance of the available 25 hours which is not used in connection with the Projects to be submitted for certification purposes may be used to undertake practice Projects using the specifications issued by SQA, or for other practical work defined by the teacher. The arrangements for the internal assessment of Practical Abilities are detailed in section 6.

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## **6 ASSESSMENT FOR CERTIFICATION**

### **6 1 Certification**

Candidates will be assessed by a system common to all Levels. The Certificate will record an overall award on a 7-point scale of grades, grade 1 being the highest. The Certificate will also record attainment in each element. The overall award will be the mean, rounded as necessary, of the element grades, weighted as described in paragraph 6 3 2 below.

### **6 2 Assessable Elements**

6 2 1 Knowledge and Problem Solving is concerned with the demonstration of the ability to

recall;  
describe;  
explain computing facts and concepts;  
analyse problems and design solutions;  
evaluate solutions.

6 2 2 Practical Abilities is concerned with the demonstration, in a variety of practical situations, of the ability to

analyse problems and design solutions;  
implement practical solutions;  
evaluate practical solutions.

6 2 3 Core Skills is concerned with the demonstration of the ability to

use an IT system effectively;  
perform processes using a range of application packages;  
carry out searches to extract and present relevant information.

### **6 3 Internal and External Assessment**

6 3 1 Knowledge and Problem Solving will be assessed externally by written examination.

Practical Abilities will be assessed internally, with external moderation by SQA.

Core Skills will be awarded according to the overall grade achieved as described in section 6 6.

6 3 2 The weighting of the elements will be in the ratio of 2:1 respectively for Knowledge and Problem Solving and Practical Abilities. After applying the weightings the overall grade will be determined by adding, dividing by 3 and rounding to the nearest whole number.

## **6 4 Grade 7 and No Overall Award**

For any element, grade 7 will indicate that the candidate has, in the element concerned, completed the course but has not demonstrated achievement of any specified Grade Related Criteria level of performance.

SQA will regard the submission of an estimate grade for an internally assessed element as evidence that the course has been completed in that element.

Candidates who have not complied with the assessment requirements in either element (eg due to unauthorised absence from the external examination or failure to submit Project work) will be deemed not to have completed the course, in that element. Such candidates will not receive a grade for that element and hence will not receive an overall award for the subject. In such cases, however, grade(s) for the other element(s) will be recorded on the Certificate.

## **6 5 Internal Assessment of Practical Abilities**

6 5 1 The two types of Project to be assessed internally in connection with Practical Abilities are:

Non-Programming Project;  
Programming Project.

6 5 2 Candidates will keep a Folder of their individual Project work to be used for the assessment of Practical Abilities. Internal assessments may be subject to moderation and Folders of Project work must therefore be available for submission to SQA by 31 March prior to the external examination. The Folder of Project work should be produced in A4 format or folded to A4 size in a folder other than a ring binder and should be labelled clearly with the candidate's name.

6 5 3 Project Work

Project work, Project specifications and the associated marking schemes are described in section 5. Candidates' work should be assessed at stages throughout the development of each Project. If judged necessary, assistance may be given by the teacher so that failure in one part of a Project does not preclude achievement in a subsequent, related part. Any assistance given should be noted, since it is likely to have influenced the marks awarded by the teacher.

For each Project that is to be submitted for certification purposes, candidates will be required to complete a Project Report which should be retained in their Folder of Project work. The Project Report should not bear any marks or comments by the teacher.

Teachers must ensure that candidates attempt Projects at a Level consistent with their abilities. The marking scheme for each Project specification supplied by SQA will be applied by the teacher to each candidate's work, and the grade obtained by the candidate determined in relation to the cut-off scores detailed in the marking scheme. Where Project work has been attempted but the score for the Project is less than the lowest cut-off score for that Project, grade 7 should be awarded. The grade for Project work will be used as described in paragraph 6 6 when deciding on the grade for Practical Abilities.

## **6 6 Core Skills**

Candidates awarded a Grade of 5 or 6 for Computing will be awarded Information Technology Access 3 Core Skills.

Candidates awarded a Grade of 3 or 4 for Computing will be awarded Information Technology Intermediate 1 Core Skills.

Candidates awarded a Grade of 1 or 2 for Computing will be awarded Information Technology Intermediate 2 Core Skills.

## **6 7 Determining the Grade for Practical Abilities**

- 6 7 1 The overall grade for Practical Abilities is that grade which, in the judgement of the teacher, best reflects the level of attainment of the candidate and is supported by the evidence in the Folder of Project work.

The overall grade for Practical Abilities is the mean of the grades assigned to each of the Projects and where necessary rounded up or down to a whole grade.

For example, a candidate who scored grades of 1 and 2 for the Projects would be graded for Practical Abilities at:

Grade 1 if the Project awarded grade 2 was carried out early in the course and the Project awarded grade 1 carried out late in the course represented the candidate's present performance;

Grade 1 if the Project awarded grade 2 was only just below the cut-off for a grade 1 and the Project awarded a grade 1 was well over the cut-off for that Project;

Grade 2 if the Project awarded grade 1 was carried out early in the course and the Project awarded grade 2 carried out late in the course represented the candidate's present performance;

Grade 2 if the Project awarded grade 1 was only just above the cut-off for a grade 1 and the Project awarded a grade 2 was well below the cut-off for that Project.

Where the teacher considers for any reason that the grade awarded for Practical Abilities does not fairly reflect the candidate's overall performance, the teacher may award a grade other than the mean, in which case an explanatory note should be submitted and any relevant, additional evidence included in the Folder of Project work.

## 6 8 Presentation and External Papers in Knowledge and Understanding and in Problem Solving

- 6 8 1 A grade for Knowledge and Problem Solving will be derived from the external examination papers that will be set and assessed by SQA. Three papers, designated Foundation (assessing grades 6 and 5), General (assessing grades 4 and 3) and Credit (assessing grades 2 and 1), will be offered.

At the time of presentation, centres will be required to indicate the Level(s) of the external papers which each candidate will attempt, as follows:

Foundation and/or General Level(s),  
or General and/or Credit Level(s) only.

This presentation does not imply any restriction on grades available for Practical Abilities.

Candidates presented at two Levels are not obliged to attempt both papers but are strongly advised to do so, since, other than as a result of an appeal, candidates can only be awarded one of the grades assessed by the paper(s) attempted, or grade 7.

The following table may be helpful as a guide to presentation.

<i>Expected External Grade</i>	<i>Presentation Level(s)</i>	<i>Grades Assessed</i>
7, 6	Foundation	6, 5
5, 4	Foundation and General	6, 5, 4, 3
3, 2, 1	General and Credit	4, 3, 2, 1

This arrangement allows in each case for a grade award higher or lower than expected (except at grades 1 and 7 respectively). A candidate expected to achieve grade 6 may choose to be presented for both the Foundation and the General papers. A candidate expected to achieve grade 3 may choose to be presented for the Foundation and General combination of papers, thereby accepting that grade 2 and grade 1 will not be possible.

For Knowledge and Problem Solving, candidates will be allocated a grade on the basis of their performance in the external paper. Candidates who attempt two papers will be given the better of the two grades achieved. Performance in one Level will not be taken into account in grading at the other Level.

6 8 2 The duration of the external papers is as follows:

Paper	Grades	Duration
	Assessed	
Foundation	6, 5	1 hour
General	4, 3	1¼ hours
Credit	2, 1	1¾ hours

Within each paper, there will be no choice of questions.

6 8 3 In line with the Grade Related Criteria (GRC) defined in Section 7, the responses expected of candidates will increase in complexity from short phrases and sentences at Foundation Level to concise descriptions, explanations and reasoning or extended answers at Credit Level. As a consequence:

the Foundation Level Paper will consist mainly of short response questions;

the General Level Paper will consist of short and extended response questions;

the Credit Level Paper will consist of questions that demand extended, in-depth responses.

6 8 4 Marks will be allocated to each question and a total mark obtained. The two grades associated with each Level will be distinguished by setting two cut-off scores. The lower score (in the region of 40 - 50% of the available marks) will reflect a satisfactory overall standard of performance, the upper score (in the region of 70 - 80% of the available marks) a high overall standard of performance.

## **6 9 Estimate Grades for Knowledge and Problem Solving**

Towards the end of the course the teacher should consider representative examples of each candidate's work, such as 'prelim' examinations, end-of-topic tests and completed worksheets. On the basis of this, the teacher will assign an estimate grade for Knowledge and Problem Solving which must be submitted to SQA, by 31 March of the year of the examination.

The estimate grade may be used by SQA for its internal procedures, including such cases as absence from external examination, adverse circumstances and appeal. Evidence in support of the estimate grade should therefore be retained by centres for submission to SQA if required.

## **6 10 Moderation Procedures**

Presenting centres will be informed by SQA of the procedures that will operate in connection with moderation of the internal assessment of Practical Abilities.

## **6 11 Summary of Information to be available to SQA**

### **6 11 1 Assessments**

On the appropriate form and by the due date, SQA will require the following for each candidate:

Knowledge and Problem Solving

an estimate grade for Knowledge and Problem Solving

Practical Abilities

the overall grade for Practical Abilities.

### **6 11 2 Evidence to be Retained by the Presenting Centre**

The Folder of Project work for each candidate, other than those submitted to SQA for moderation purposes, is to be retained by the presenting centre in case it should be required for re-grading following moderation.

In addition, centres should retain evidence to support the estimate grades for Knowledge and Problem Solving.

## **7 GRADE RELATED CRITERIA**

### **7 1 Definitions**

Summary Grade Related Criteria (GRC) are broad descriptions of the performance against which a candidate's achievement is measured. Comparisons are not made between the performance of one candidate and that of another. They are used as general guidance for the determination of grades.

Extended Grade Related Criteria (EGRC) are more detailed descriptions of the performance in the specific abilities associated with the two assessable elements - Knowledge and Problem Solving and Practical Abilities.

### **7 2 Application of Summary Grade Related Criteria**

GRC are defined at three Levels of performance - Foundation, General and Credit. Awards will be reported on six grades, two grades being distinguished at each Level. The upper of the two grades at a given Level will be awarded to candidates who meet the stated criteria demonstrating a high standard of performance; the lower grade to those who demonstrate a lower, but still satisfactory standard of performance. There will be a seventh grade for candidates who complete the course but fall to meet the stated criteria for any Level.

#### **7 2 1 Knowledge and Problem Solving - Summary Grade Related Criteria**

The candidate has demonstrated the ability to communicate knowledge and problem solving by recalling information; describing main features and giving explanations in response to questions; applying knowledge; analysing, designing and evaluating solutions in response to problems.

##### **Foundation Level (Grades 6, 5)**

At this level the questions and problems would be straightforward and the answers would be in the form of short phrases and sentences.

##### **General Level (Grades 4,3)**

At this level the questions and problems would be neither straightforward nor complex and the answers would be in the form of phrases and sentences involving short descriptions and explanations.

##### **Credit Level (Grades 2, 1)**

At this level the questions and problems would be complex and the answers would be in the form of concise or extended descriptions and explanations.

## 7 2 2 Practical Abilities - Summary Grade Related Criteria

### Foundation Level (Grades 6, 5)

The candidate has demonstrated the ability in straightforward practical situations, given step-by-step instructions, to analyse problems and design solutions and to use computers to implement and evaluate practical solutions.

### General Level (Grades 4,3)

The candidate has demonstrated the ability in practical situations, given detailed instructions, to analyse problems and design solutions and to use computers to implement and evaluate practical solutions.

### Credit Level (Grades 2, 1)

The candidate has demonstrated the ability in practical situations, given outline instructions, to analyse complex problems and to use computers to implement and evaluate practical solutions.

### 7 3 Application of Extended Grade Related Criteria

EGRC are defined at three Levels of performance - Foundation, General and Credit.

#### 7 3 1 Knowledge and Problem Solving - Extended Grade Related Criteria

The candidate:

*recalls information* - by stating facts about items of detailed content;

*describes* - by pointing out the main features of items of detailed content;

*explains* - by giving reasons for the main features of items of detailed content;

*analyses problems* - by describing, from the information available, the fundamental nature of the problem and by identifying the main features of the problem which are relevant to its solution;

*outlines solutions* - by describing the constituent processes which are necessary to carry out the task and the sequence in which they should be performed, recognising as appropriate where the use of standard techniques or existing software would be relevant;

*refines solutions* - by describing in an appropriate form how the main stages can be developed to a point where they can be implemented;

*discusses strategies* - by explaining why a particular approach is adopted;

*assesses the adequacy of solutions* - by comparing the solutions to problems with the original objectives or criteria by identifying any discrepancies and explaining these where appropriate;

*considers implications* - by identifying potential social, economic, technical and/or legal consequences of a particular problem and its solution;

*suggests improvements* - by identifying possible enhancements to a proposed solution or changes to a strategy.

#### Foundation Level (Grades 6, 5)

At this Level, the candidate gives answers in the form of short phrases and sentences, to straightforward questions and solutions to problems related to the detailed content for Foundation Level. The problems will be concerned with simple applications of computing, and could involve, for example, choosing the correct steps from given options or putting steps into the correct order.

#### General Level (Grades 4, 3)

At this Level the candidate gives answers in the form of phrases or sentences involving descriptions or explanations to questions and solutions to problems set in common situations related to the detailed content for General Level. The problems may require judgements to be made on contrasting views and formulation of balanced opinion and some justification of the adequacy of solutions.

## Credit Level (Grades 2, 1)

At this Level the candidate gives concise or extended answers involving descriptions, explanations or reasoning to questions and solutions-to problems set in a variety of situations related to the detailed content for Credit Level. The problems may require the candidate to make inferences and provide reasoned arguments to justify choice of strategy and adequacy of solutions.

### 7 3 2 Practical Abilities - Extended Grade Related Criteria

The candidate, using a computer as appropriate and working in a practical context:

*analyses problems* - by describing, from the information available, the fundamental nature of the problem and by identifying the main features of the problem which are relevant to its solution;

*outlines solutions* - by describing in an appropriate form (eg structure chart, pseudocode) the constituent processes which are necessary to carry out the task and the sequence in which they should be performed, recognising as appropriate where the use of standard techniques or existing software would be relevant;

*refines solutions* - by describing in an appropriate form how the main stages can be developed to a point where they can be implemented;

*discusses strategies* - by communicating orally with peers, teachers and other adults in an appropriate manner;

*obtains information* - by making use of system or software documentation as appropriate to the type and level of tasks involved in implementing a solution.

*uses hardware effectively* - by successfully completing tasks based on well-organised management of hardware, good planning of sessions at the computer and good housekeeping.

*uses appropriate software tools effectively and efficiently* - by implementing the design through the appropriate use of the operating system, a software package or programming language to achieve the planned computer solution which makes best use of available facilities.

*identifies and rectifies errors* - by testing the implementation of a solution at appropriate stages during its development and, by recognising an error and its type, diagnosing the associated fault and taking appropriate action.

*writes documentation* - by producing two broad categories of documentation: internal commentary as part of the software developed; and both user and technical notes.

*reports on / discusses progress* - at any stage, by comparing the current state of the implementation with the design and original requirements of the problem and, on conclusion of the task, by producing a commentary of the means by which the final outcome was achieved; this may involve a diary of events, a note of any difficulties encountered and how they were handled, or a description of the way a particular task was carried out, indicating the roles of others involved in the task, if appropriate.

*assesses the adequacy of solutions* - by using test data and reporting on the results and by comparing the final outcome with the original brief, identifying any discrepancies and explaining these where appropriate.

*considers implications* - by identifying potential social, economic, technical and/or legal consequences of a particular problem and its solution.

*suggests improvements* - by identifying possible enhancements to the solution, changes to the strategy adopted or changes to the original brief which would provide a more effective solution.

#### Foundation Level (Grades 6, 5)

At this Level the candidate plans and carries out practical activities of a straightforward nature with the aid of step-by-step instructions.

#### General Level (Grades 4, 3)

At this Level the candidate plans and carries out practical activities of limited complexity with the aid of detailed instructions.

#### Credit Level (Grades 2, 1)

At this Level the candidate plans and carries out practical activities of a complex nature with the aid of outline instructions.

EXEMPLAR PROGRAMMING SPECIFICATION - COMAL			
MAIN ASPECT	F/G/C	G/C	C
REPRESENTATION OF SOLUTION TO PROBLEM	one simple representation (eg structure chart).		use a variety of representations (eg pseudocode, structure charts).
PROGRAM ENTRY	enter; edit; list/print out program.		
SEQUENCE	simple instructions.		
MODULARITY	sensible arrangement of blocks of code	simple procedures (ie PROC ... ENDPROC).	
SIMPLE DATA TYPES	numeric; string.		integer; real; boolean.
STRUCTURED DATA TYPES			reserve space (DIM); one-dimensional arrays.
DATA INPUT AND OUTPUT	keyboard input of numeric and text data (INPUT); output of numbers and text (PRINT).	presupplied data (READ ... DATA); formatting of output (, ; TAB).	
STATEMENTS	assignment of constants (eg boxes := 6); assignment of expressions (eg total := price + vat).	assignment of increments (eg counter := counter + 1).	
EXPRESSIONS	simple, common keywords and arithmetic operators.	common pre-defined functions; comparison operators.	logical operators (AND, OR, NOT).
REPETITION	fixed loop (FOR ... ENDFOR).	control variable used in loop.	nested loops;  conditional loop (WHILE ... ENDWHILE, REPEAT ... UNTIL).
SELECTION		simple selection (IF ... THEN ... ENDIF).	two-way selection (IF ... THEN ... ELSE ... ENDIF); multiple selection (CASE ... WHEN ... OTHERWISE ... ENDCASE).
IDENTIFY AND RECTIFY ERRORS	syntax, execution and logical errors.		
TESTING	use supplied test data.	use own test data.	supply full set of test data.
READABILITY	use meaningful variable names; include comments.	use meaningful procedure names.	
USER INTERFACE	screen layout; prompts to user.		input validation.

EXEMPLAR PROGRAMMING SPECIFICATION - PROLOG			
MAIN ASPECT	F/G/C	G/C	C
REPRESENTATION OF SOLUTION TO PROBLEM	one simple representation (eg data flow diagram).		use a variety of representations (eg data flow diagram, AND-OR tree).
PROGRAM ENTRY	enter; edit; list/print out program.		
SEQUENCE	anticipate effect of clause and condition sequencing upon execution.	improve performance through clause and condition re-sequencing.	optimise performance through rule and condition re-sequencing.
MODULARITY	group similar clauses together; deploy shallow goal chaining.	use clauses with parameters; write multi-clause procedures.	deploy deep goal chaining; use extensive parameter passing.
SIMPLE DATA TYPES	numbers; words.		
STRUCTURED DATA TYPES		lists.	structures.
DATA INPUT AND OUTPUT	construct simple queries; interpret output.	construct queries with several goals.	
STATEMENTS	write facts; write rules that call facts.	write rules with basic primitives (eg is, write); write rules that call other rules.	write recursive rules.
EXPRESSIONS	simple arithmetic.	term unification.	
REPETITION	negation; unification; goal reduction for variable free goals.	goal reduction for goals with variables.	
IDENTIFY AND RECTIFY ERRORS	diagnose syntax, execution and logic errors;		
TESTING	use supplied test queries.	supply own test queries.	supply full set of test queries.
READABILITY	meaningful variable names; internal commentary.		
USER INTERFACE	query I.O only.	programmed I/O (read, write).	if available: system primitives for GUI I/O.

EXEMPLAR PROGRAMMING SPECIFICATION - VISUAL BASIC			
MAIN ASPECT	F/G/C	G/C	C
REPRESENTATION OF SOLUTION TO PROBLEM	labelled diagram of HCI specifying objects.	identification of variables and their types.	pseudocode for subprograms.
PROGRAM ENTRY	enter; edit; list / print code.		
MODULARITY	subprograms linked to command events.	flow of data between subprograms.	
SIMPLE DATA TYPES	integer; single; string.	timer.	boolean.
STRUCTURED DATA TYPES			one dimensional arrays.
DATA INPUT AND OUTPUT	command button; text box; label.	input box; option button; message box.	list box; combo box; check box.
STATEMENTS	assignment of constants (eg boxes := 6); assignment of expressions (eg total := price + vat).	assignment of increments (eg counter := counter + 1).	
EXPRESSIONS	simple, common keywords and arithmetic operators.	common pre-defined functions; comparison operators.	logical operators (And, Or, Not).
REPETITION	fixed loop (For ... Next).	control variable used in loop.	nested loops;  conditional loop (Do ... Loop While ..., Do ... Loop Until ...).
SELECTION		simple selection (If ... Then ... End If)	two-way selection (If ... Then ... Else ... End If); multiple selection (Select Case).
IDENTIFY AND RECTIFY ERRORS	syntax, execution and logic errors.		
TESTING	use supplied test data.	use own test data.	supply full set of test data.
READABILITY	use standard notation for objects (eg txtName); use meaningful object variable names; include comments.		
USER INTERFACE	design HCI; create / edit / position objects; set initial object properties.	prompts to user.	input validation.