COMPUTING STUDIES

Introduction

Computing Studies is offered in 2 Unit General, 2/3 Unit (Common) and 3 Unit (Additional) courses. In this first year of offering such a range, the total candidature is now 11,204 - 2 Unit General comprising 3099 students, 2/3 Unit (Common) 7021 and 3 Unit 1084.

Both the 2 Unit and 3 Unit courses were designed to build on a common Preliminary course which provides a firm foundation in basic skills and concepts, computer-based systems, algorithms and the use of common application software. Both of the Higher School Certificate courses were designed to provide a balance of theory and practice.

The 2 Unit (General) course is designed to meet the needs of students who wish to understand how computer applications can be used to solve problems of relevance to them. Students learn how the hardware and software work together, how the computer can be instructed to carry out a task, how to design solutions and how to use computer applications effectively and efficiently. In short, they learn how existing software packages and appropriate hardware can be used to solve problems.

The 2/3 Unit (Common) course is designed to meet the needs of students who wish to understand how computer-based systems are designed, how the system carries out its task and how the computer can be instructed to carry out new or different tasks. In short, they learn how to design, create and implement computer solutions in a selection of application areas.

2 UNIT (GENERAL)

3099 candidates presented for this paper which consisted of:

Section I - 20 multiple choice questions
Section II - five questions, each on one of the five topics.

Section I

The average mark on the multiple choice questions was 9.48 with a standard deviation of 3.1.

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The item analysis for Section I follows.

A very small percentage of candidates (not shown below) failed to mark a selection or marked multiple choices.

	Choice A		Choice B		Choice C		Choice D	
Item	%	mean	%	mean	%	mean	%	mean
1	31.45	8.8	10.74	9.0	26.62	8.9	**30.89***	**11.0***
2	**49.05***	**10.9***	17.73	8.2	22.31	7.9	10.32	8.6
3	**22.11***	**11.2***	15.12	9.7	27.27	9.0	35.04	8.7
4	33.08	8.8	18.39	8.8	17.96	9.5	**30.27***	**10.6***
5	23.71	8.2	**33.12***	**10.9***	12.44	8.5	30.44	9.4
6	15.12	8.1	2.81	7.7	**44.48***	**11.0***	37.30	8.3
7	**77.92***	**10.2***	4.70	6.3	14.27	7.3	2.74	6.2
8	15.77	8.3	**54.60***	**10.6***	11.37	8.8	17.96	7.5
9	3.63	7.31	4.44	8.0	17.64	7.6	**64.04***	**10.5***
10	19.60	8.4	66.36	9.9	**12.25***	**9.6***	1.47	6.3
11	2.35	6.7	2.32	6.7	**15.41***	**11.4***	79.65	9.3
12	5.23	6.6	5.62	6.2	**86.19***	**10.0***	2.68	6.7
13	9.80	7.6	**69.30***	**10.4***	3.00	7.1	17.60	7.5
14	16.59	7.7	**47.88***	**10.6***	7.15	6.6	27.99	9.4
15	26.52	8.8	**56.89***	**10.2***	12.28	8.9	4.11	6.0
16	**32.72***	**10.4***	11.23	8.3	20.61	8.4	35.17	9.6
17	10.84	8.8	39.48	9.1	**23.91***	**10.6***	25.44	9.3
18	**76.65***	**10.2***	15.87	7.7	4.41	6.7	2.81	6.1
19	3.63	6.6	5.98	7.0	27.79	8.6	**62.31***	**10.3***
20	**57.61***	**10.7***	17.41	8.2	5.09	7.6	19.30	7.6

Note: On Section I mean is the average mark of the students who selected that choice.The correct choice is indicated by **figures in bold** and *****.
In most cases the mean mark for those students who selected the correct answer was higher than the mean for any of the other choices. Question 10 is the exception in which a number of the better students selected choice B.

Section II

Answers seemed to indicate that the students had little idea of the underlying theory behind the application but appear to have had considerable experience in using the application.

Students are reminded that the practical work must be balanced with the theoretical understanding required by the Syllabus.

Question 21 : Spreadsheets

In this question candidates could not achieve high marks unless they were familiar with the necessary practical component of the course. A large number were unable to layout a spreadsheet or provide suitable formulae. This could indicate that the students were given practice in using prepared spreadsheets but little or no practice in creating their own.

(a) In this part some candidates provided a definition of a *template* unrelated to spreadsheets. It is again emphasised that students must know and use the terminology related to the subject correctly. It should not be necessary in a Computing Studies paper to include words in the question to show that the answer must refer to a computing studies context.

A large number of candidates could not supply an example of a macro or confused the concept with an inbuilt operation such as *fill down*, a shortcut command to print the spreadsheet such as *command-p*, or the application of a formula. The question: *Give an example of where a macro might be used* elicited responses such as *in a real estate office* which could indicate a lack of understanding by the student.

(b) (i) Here few students were able to identify the problem as a circular reference. Some knew that the cell referred to itself, but a large number simply stated that it had no value.

(ii) Very few candidates correctly identified the function as COUNT.

(iii) Many students provided names of expenses rather than identifying the data block as asked.

(iv) This appeared to be a subjective question. Many students simply selected one of the two charts and stated *it was easier to see*, thus attracting no marks.

(c) The provision of the grid page allowed most students to make some attempt at this part, with the well-prepared candidates scoring well.

(i) The common error here was to write formulae using the supplied **values** rather than the cell references, which is the power of spreadsheets.

(ii) This part, which asked for identification of *input, output, calculation* and *instruction areas* on the grid areas, was poorly done, indicating students' possible lack of use of this terminology when learning the topic.

(iii) In the *what-if* question, too many students omitted any discussion of the reason for making the change. Some gave as their answer *What if the capacity of the buses changed?* without indicating that this would be done to see how it would affect the number of buses and hence the cost.

Question 22 : Databases

The question assessed understanding in a variety of areas, thus allowing most students to score some marks. Very rarely did a candidate score high marks in all three parts of the question. Many answered a few parts very well but seemed to have little idea of others.

(a) (ii) A number of students responded in terms of the general issue of computerised database compared with paper database rather than in terms of the database of this specific motel as described in the stem. Students talked about situations such as libraries, schools and doctors' surgeries in which an electronic database would be quicker to use than the corresponding manual system. The question required answers in terms of motel situations such as preparing accounts, checking for unoccupied rooms at registration, etc.

(b) Many students misinterpreted the contents of the field *guest ID* by referring to photo driver's licences, etc, rather than to a motel-generated unique number.

(iii) Here students did not use all of the space available in the frame as an outline of the screen but, instead, drew a smaller screen within the border. Screen designs usually indicated only the placement of the fields with no prompts or on-screen help.

(c) (i) This part caused problems; many students apparently could not understand the reason for the search and, therefore, could not identify the cues given for forming the search specification. Response to the second part concerning the automatic preparation of individual letters was poor.

(ii) The social implications examined in this part did not seem to be well understood and a number of students misunderstood the implication that motel staff actually listened in to the calls. In both instances many argued that the action was not an invasion of privacy, whereas the question sought a balanced argument taking both points of view into consideration.

Question 23 : Graphics

(a) The majority of candidates scored well in this part, although some showed no understanding of the purpose of the graphs. More careful reading of the question would have elicited better responses since many answers simply referred to the general concept of *the size of the graphs*. To gain full marks the candidate had to refer to both the change in scale and the change in starting point.

(b) (i) Those who attempted part (i) showed a good understanding of the transformations required. Many candidates made no attempt to answer this part, perhaps reflecting a weakness in their understanding of the topic. In the case of the *distortion*, a large number of students redrew the figure with wobbly or broken lines rather than with a change in the aspect ratio.

(ii) Here there was obvious confusion between *path-based* and *cel-based* animation and between *types of animation* and *types of graphics*, since many candidates discussed the difference between *bit-mapped* and *vector-based* solutions.

(c) The mathematical parts were attempted by most students, the majority of whom gained at least half the available marks. On the other hand, a disappointingly large number did not attempt parts (iii) and (iv) and the answers of those who did so were often trite - simply stating that *static* means *still* and *dynamic* means *active*. Correct terminology was rarely used or understood.

Question 24 : Desktop Publishing

The quality of answers was generally fair. This was one topic in which the level of knowledge and understanding of terms associated with desk top publishing were obviously poor. Terms such as *kerning* and *leading* were confused, and those such as *master page* and *typeface* were not widely known.

Students are again reminded of the necessity to read the questions carefully and to answer the question asked, e.g. many failed to answer part (b) (iii) with reference to the **text** of the brochure.

(a) Here *ruler guides*, which are the non-printing guidelines used to help position elements on a page, were commonly confused with the *rulers* across the screen in word processing packages to assist with automatic formatting such as page width, tab stops and so on.

Kerning was confused with the space between lines rather than the space between letters, and the *gutter* (the space added to the inside margin to allow for binding) was often perceived to be at the bottom of the page and hence confused with the *footer.*

Students were confused about aspects of the sample document presented which were unrelated to the question - design and DTP. They stated that:

(i) the document should be folded in two rather than three,

the body of the text was in Latin and hence conveyed little information to the reader, and that

two pages were provided and there was only one in the brochure, not realising that they were the front and back of a single page.

The commonly identified **design faults** concerned the placement of the graphics with respect to the text, the fonts used, the mix of fonts used, and the positioning of the items on the *front cover* which would not fold as required. Few needed to identify other errors such as the placement of the *Science* heading at the bottom of the page separate from its body text, or the change in its alignment compared with the other faculty headings.

(ii) While there were many good answers to this part, too many failed to include the cropping and editing of the picture. Students might have believed that this would be done by scissors in preparing the original magazine picture for scanning, rather than incorporating the electronic processes to complete the work.

(iii) The biggest error here was failure to relate the answer to **text** as required.

(c) This was another question in which a failure to read the question carefully resulted in an unnecessary loss of marks.

(iii) This asked for *two ways to improve readability **in this situation***; marks were lost through correct but inapplicable techniques being stated.

Question 25 : Computer Communication

In answers to this question poor grammar and poor expression meant ideas were communicated badly. There seems to be some evidence that students knew what to do but could not explain the reason(s).

A number of students did not attempt complete sections of the question. Many suggested that reducing the font size or reducing the kerning would lessen the amount of text to be transmitted, thus showing not only a lack of understanding of compression techniques but of the communication process itself in terms of what is actually transmitted.

(c) Likewise, answers to this part indicated that some practical work had been done, but little or no theoretical underpinning was apparent.

(iii) Answers here showed no understanding of the concept of *private* mail sent to a user's mailbox and accessible only to the box holder, compared with *public* mail sent to a common mailbox (bulletin board) accessible to all users in the same group.

2/3 UNIT (COMMON)

The 8105 candidates (72% of the total candidature) who presented for this paper was made up of:

Section I - Core

Part A
20 multiple choice questions

Part B
2 questions - one on each of the Core topics

Section II - Options

Seven questions, each on one of the optional topics of which each candidate was required to answer three.

Section I

Part A

The item analysis for Part A follows.

A very small percentage of candidates (not shown below) failed to mark a selection or marked multiple choices.

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	Choice A		Choice B		Choice C		Choice D	
Item	%	mean	%	mean	%	mean	%	mean
1	6.54	8.7	1.79	9.7	3.76	9.8	**87.84***	**13.1***
2	4.43	10.1	23.52	11.3	**62.16***	**13.7***	9.68	10.3
3	15.37	11.1	**59.24***	**13.9***	17.67	11.0	7.51	9.9
4	18.90	11.3	**66.04***	**13.6***	14.18	10.2	0.81	9.4
5	7.50	11.1	16.13	10.9	**68.82***	**13.4***	7.31	10.9
6	3.82	7.8	**81.96***	**13.3***	9.19	10.2	4.97	9.8
7	**58.56***	**13.7***	3.14	10.8	15.00	11.22	2.99	11.0
8	7.92	9.6	15.55	11.5	6.83	9.6	**69.53***	**13.5***
9	14.46	9.9	12.50	11.2	**65.72***	**13.6***	7.17	12.0
10	7.13	9.3	3.17	8.1	2.25	8.2	**87.36***	**13.2***
11	3.44	9.6	12.25	9.3	**79.28***	**13.4***	4.93	10.4
12	29.44	11.8	**53.07***	**14.0***	7.00	9.4	10.30	10.2
13	14.45	10.1	6.09	9.1	39.92	12.4	**39.36***	**14.3***
14	**65.32***	**13.9***	22.65	10.7	8.92	9.3	2.97	9.2
15	22.70	11.9	**54.66***	**13.8***	5.89	10.2	16.57	10.7
16	23.81	11.5	8.82	11.4	**55.67***	**13.6***	11.44	11.2
17	8.08	10.2	22.51	11.5	12.40	10.9	**56.91***	**13.8***
18	8.79	10.8	13.58	11.4	26.13	11.1	**51.14***	**14.0***
19	13.69	10.7	36.48	13.0	**38.33***	**13.6***	11.23	10.5
20	27.07	11.9	**60.98***	**13.4***	5.36	9.8	6.38	10.5

Note: *Mean* is the average mark on Choice A of the students who selected that choice.

In most cases the mean mark for those who selected the correct answer was higher than the mean for any of the other choices.

Question 13 is an exception in which a number of the better students selected choice C.

Question 19 is another exception in which the better students were split between choice (B) and the correct answer (C). Since there are three paths to test, a **minimum** set of data is (C). Those who argued that the test data should include values above, below and on the boundary and who thus chose (B), were inconsistent since there is no value greater than 5 for testing the outer selection.

Part B

Question 21 : Computer-based Systems

(a) This question was very poorly answered.

Many students did not attempt this part and those who did so presented poor, verbose and inappropriate answers. Students generally appeared to have little understanding of the terminology and concepts being examined. Answers to this part indicated a greater reliance on case studies from commonly used text books than on the completion of a major investigation of an application of computer technology as required by the Syllabus.

Few students were able to identify *technical factors* as required, but selected societal, temporal or operational factors. Even those who could identify appropriate factors could not relate their discussion back to the investigation nor could they explain how such factors affected the decisions made about the feasibility of the system.

(b) (i) Most students were able to score here. Those who failed to do so often provided trite answers such as *custom-written software is easier to use* or *is less expensive*. Such general answers will attract few marks.

(ii) This part was reasonably well answered, although some students did not indicate whether the stated implication was positive or negative.

(iii) The reference to *real* data as opposed to *test* data in this part was not readily understood. Many students completely misinterpreted the question and answered as though the terms were synonymous, consequently they scored poorly.

(iv) This was also poorly answered as many students had little knowledge of a data-flow diagram. Some students had difficulty in answering since their model of a data-flow diagram included more than 4 elements of the system.

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Question 22 : Algorithm Design

It was pleasing to note that very few candidates either failed to attempt this question or scored no marks. In previous years similar questions have often been omitted by a large number of students. It is a matter of concern that the answers indicated that many students who are capable of correcting an existing algorithm are unable to develop their own algorithm from a problem statement. More attention needs to be given to this aspect of the subject.

(a) (i) Here most students performed well, with the better students including boundary conditions.

As the question described a physical situation it was expected that students would apply reason before simply applying remembered generalisations. Marks were deducted for test data which included negative or zero values, unless it was accompanied by a sensible explanation, since it is unrealistic to consider a person of zero or negative weight, or of zero or negative height.

Providing a fixed number of rows for the answer caused some problems in that some weaker students felt they had to fill all rows and so duplicated combinations or used inappropriate combinations in their answers, others required more than the nine provided. The convention is to provide sufficient lines for the most verbose answer but correct answers which require fewer lines are not penalised.

There was some obvious misunderstanding of the terms *at least* and *or* since the expected results for particular combinations of test data were often incorrect.

(ii) In this part some problems were caused by a small number of students who confused the meaning of the signs >, , and <. Most were able to recognise the need for the OR structure but could not implement it correctly or became confused with the correct pseudocode structures involving the placement of ELSE and ENDIF. Students tended to have more success when they described the algorithm in flowchart form. The opposite was true in the case of 3 Unit candidates (Question 22 of 3 Unit (Additional) paper).

(b) Here students who chose flowcharts as their preferred method of algorithm description tended to perform better in scoring mid-range marks than those who chose pseudocode. Good pseudocode users, however, often gained maximum marks.

The major problem with the responses was that students failed to identify all of the processes needed in their solution. Those most often missed were:

- the need for a looping structure
- the detailed logic for making the correct age decision
- the need to maintain two counters (*Juniors* and *Seniors*) for printing out totals, even though only the Seniors were restricted in numbers
- distinguishing between *writing* data to a file and *printing* data
- failing to print the numbers in each category but printing the details of each member instead.

Section II - Options

This part of the paper contained the seven questions of which students were required to answer three corresponding to the Options studied. Students are advised **against** attempting questions for which they are not formally prepared, and also **against** answering more than three questions, since the result of this is that the time available per question is reduced.

The number of candidates attempting each of the Option Topics is as follows:

	2 Unit		3 Unit		Total	
	n	%	n	%	n	%
Applied AI & Expert Systems	938	13.7	133	12.3	1071	13.5
Computer Communications	6008	87.8	936	86.7	6944	87.6
Computer-Controlled Systems	**779***	**11.4***	82	7.6	861	10.9
Computing Technologies	1788	26.1	299	27.7	2087	26.3
Database Design	**5457***	**79.7***	785	72.7	6242	78.8
Graphical Techniques	4858	71.0	**807***	**74.7***	5665	71.5
Multimedia	1205	17.6	**231***	**21.4***	1436	18.1

Note: Cells marked with ***** show topics where there is a 3 or 4 percent difference between the choices made by 2 Unit and 3 Unit candidates.

The following tables show the mean mark achieved on each of the Options (out of 20) together with the mean mark achieved by that group of students on the Core (out of 40). The correlation coefficient between the two mean scores is also given.

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All 2/3 Unit (Common) Candidates	Correlation Coefficien	Core Mean	Topic Mean
Core	1.0	22.44	22.44
Applied AI & Expert Systems	0.78	18.75	9.18
Computer Communications	0.68	22.44	9.92
Computer-Controlled Systems	0.74	20.96	6.13*****
Computing Technologies	0.73	22.79	8.79
Database Design	0.71	22.65	8.88
Graphical Techniques	0.7	23.09	8.74
Multimedia	0.71	22.17	8.45

Note: The mean scores on the Core are reasonably close, irrespective of the Option selected. The exception is the mean for Applied AI & Expert Systems.

Overall the Option means, though a little low, are generally consistent, as are the correlations between each Option and the Core. The exception is Computer-Controlled Systems (*****).

3 Unit (Additional) Candidates	Correlation Coefficient	Core Mean	Topic Mean
Core	1.0	27.28	27.28
Applied AI & Expert Systems	.55	26.47	13.76
Computer Communications	.57	27.24	12.09
Computer-Controlled Systems	.62	26.80	8.64
Computing Technologies	.70	27.55	11.66
Database Design	.57	27.64	10.82
Graphical Techniques	.64	27.35	11.23
Multimedia	.58	26.18	11.10

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2 Unit (Common) Candidates	Correlation Coefficient	Core Mean	Topic Mean
Core	1.0	21.69	21.69
Applied AI & Expert Systems	0.76	17.66	8.53
Computer Communications	0.68	21.69	9.58
Computer-Controlled Systems	0.73	20.34	5.86*****
Computing Technologies	0.71	22.00	8.32
Database Design	0.72	21.93	8.60
Graphical Techniques	0.69	22.39	8.32
Multimedia	0.70	21.41	7.94

Question 23 : Applied Artificial Intelligence and Expert Systems

About 14% of the candidature attempted this option.

There were some candidates who showed little understanding of this topic and seemed to rely on their general knowledge. Students need to practise interpreting instructions under examination conditions and should be fully advised as to the expectations of the Options Section of the Examination.

In general the question was well answered by a significant number of candidates. It was evident that some had been thoroughly prepared in all aspects of the topic; these candidates scored maximum marks. There were, however, many who displayed a limited understanding of *parse tree* and had limited experience with rule-based systems. Such candidates were unable to deal effectively with rule sets which differed in form from simple expert systems.

The number of candidates who were unable to distinguish between *intelligent* and *unintelligent* robots, or who did not understand the characteristics of *artificial vision*, was disappointing.

(a) This part was generally well answered with parts (i) and (ii) being better answered than parts (iii) and (iv). It is emphasised that specific terminology needs to be understood and not simply rote learnt for regurgitation.

(b) Most candidates realised that there was a problem with having two adjectives (*bowling* and *green*) together.

(i) Very few were able to give the full answer to this part, viz *green needs to be added to the lexicon as a noun.*

(ii) It appears from the number of poor attempts at answering this part that natural language processing needs to be more carefully studied, particularly in the construction of parse trees. Too many candidates were able to identify only parts of speech from the lexicon and constructed an incorrect, low-level parse from these.

(c) In general the areas of robotics and artificial vision were not well handled here, although there were some excellent answers. Poor answers were general and trite, showed little insight, and referred to robots as *freeing people from repetitive, dirty or dangerous tasks*. In the better answers candidates showed that an intelligent robot can, for example, respond adaptively to its environment.

Those who discussed *artificial vision* had little idea of the intelligence involved in shape recognition, edge detection or pattern matching, for example. Poor answers simply described artificial eyes or a surveillance camera, but made no mention of the *intelligent* component.

(ii) Here candidates were required to identify and describe two problems specifically related to the voice recognition system described in the question. Far too many misinterpreted the question as being about a radio that *talks* to the driver, confusing voice synthesis with voice recognition.

Most were able to identify some problems - usually those of separating the voice from background noise or the difficulty of differentiating between commands to the system and conversation in the vehicle.

(d) This part was well answered. Some candidates, however, provided very poor answers which amounted to a repetition of the conditions stated in the question in a different layout. Such answers misinterpreted *structure of an expert system* as being like a *procedurally orientated programming language*.

Candidates were expected to model their additional rules on those given in the question.

(ii) This was also well answered, with most students showing that the castle met the government regulations. In the better answers candidates listed only the rules that were used and showed a knowledge of *forward/backward chaining* and the precise order in which the rules were applied.

Poor answers evaluated all of the rules from 1 to 7 but showed no understanding of the operation of an inference engine. These weaker candidates seemed to treat the expert system as a procedural program or a database of rules to be searched sequentially.

Question 24 : Computer Communications

In general, the question was well answered by a significant number of candidates, a number of whom gained maximum marks for extremely high quality answers.

Many students showed a reasonable knowledge of the terminology, but were unable to relate their knowledge to the specific question.

There were also a significant number of students who possessed a poor grasp of the terminology and gained marks only from the less theoretical and more practical parts of the question.

(a) Good answers to this part were clear and detailed.

(i) The weaker answers simply stated some known fact(s). For example, in a poor answer to *Describe the function of a modem in the transmission of data*, students simply used the terms *modulates/demodulates* and *analog/digital*, whereas a better answer described the total process of converting a digital signal from a computer into an analogue signal suitable for transmission over a communication link and converting the analogue signal received from the link into a digital form for use by the computer.

(iii) Here the weaker answers were unable to distinguish between cyclic redundancy checking and other forms of error checking. Many students talked about *removing redundant data* and *cycling through the data*, indicating a lack of preparation and a reliance on general knowledge of word meanings.

(b) (i) This was not well answered. Many students did not know the word *emulate* or its meaning. In the second part students simply gave the **number** of data bits (such as *7* or *8*) rather than ***describing the purpose of setting each of the ... communications parameters.***

This is another example, mentioned in previous years, of students' failing to read the stem of the question with each of the component parts.

(ii) Here very many candidates knew some of the features of the X-modem protocol, although full marks were rarely awarded.

(iii) This part was well answered even by those students who did not do well on the more theoretical questions, perhaps indicating that, although the practical components of the Syllabus are being taught, more emphasis needs to be placed on the required balance between theory and practice.

(c) This was generally well answered, although, once again, confusion of terminology resulted in needless loss of marks. The majority of students were able to give a balanced discussion of the use of the Internet. Most answers referred to *the provision of access to more information* as a positive effect and *access to unsavoury/illegal information* as a negative effect. They referred to *the increased access to information of people in remote areas* as a positive effect and *the need for more sophisticated and faster transmission hardware* as a negative effect.

Candidates from schools which do not have access to the Internet were not disadvantaged in answering this question. The Internet was used only as a contemporary example of an electronic information service as stated in the question. Hence, to answer this question, candidates could use their knowledge of the effects of electronic information services **in general** on education.

Question 25 : Computer-Controlled Systems

This question was answered by the bulk of the candidates in terms that were far too general.

Candidates are expected to be familiar with a wide range of sensors and effectors commonly used in the this field. This year the term *reed switch* was not widely known, while few students knew what a *pilot light* was.

Whilst algorithms have always been another weak area in this question, there was an improvement in the number of attempts and the quality of such attempts over those of previous years.

Question 26 : Computing Technologies

26% of all candidates selected this option, with almost equal numbers attempting each technology.

Candidates **must** be aware that the current Syllabus offers a choice of two technologies together with content which is common to both. For this reason the question consists of a common part (a) to be answered by all of those attempting this Option, **followed by** part (b) dealing with *Theory and Construction of Integrated Circuits* and part (c) dealing with *Optical Technologies.* Each candidate is required to answer part (a) and **either** part (b) **or** part (c).

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Too many students this year disadvantaged themselves by answering incorrect combination; some even answering all three parts. On checking average marks of the individual parts and the whole question, however, as well as correlations between the Topic mean and the Core mean, there was no apparent difference.

(a) The simpler aspects of part (a) were well done by most candidates, although many did not seem to have much understanding of the structure of the ASCII code, and thus found part (i) difficult. Knowing that the code for A (the **1**st upper case letter) is represented by decimal 65 and hence by 010**00001**, it should be obvious that the given code 010**00101** is the code for the **5**th capital letter, E.

(ii) Here most students were able to convert the 8 bit binary pattern to hexadecimal. Some converted to decimal and from there to hexadecimal - a difficult method. Those who understood the relationship between the different bases were able to convert directly by grouping the bits into sets of four and then translating each of these groups into a hex digit, 01000011 -> 0100 0011 -> 4 3.

Some had more difficulty in converting to octal since this process requires the grouping of the bits into threes - starting from the right hand digit and filling with zeros if necessary, 01000011 -> 01 000 011 -> **0**01 000 011 -> 1 0 3.

Those who used this method and got the **wrong** answer usually started from the left hand end: 01000011 ->010 000 11 -> 010 000 11**0** -> 2 0 6.

(iii) In this part the conversion from decimal to binary was well done, although too many left the answers as six bits in spite of the statement in the question, *the computer has a word length of 8 binary digits.*

Many students were unable to apply the twos complement method and simply used sign and modulus.

(iv) Answers to this part showed a low level of understanding of the division process in a base other than ten. Only about 20% of the candidates were able to carry out the division directly in binary as shown below:

Step 1

```
      1
1011) 1001101
      1011
```

Step 2

```
      1
1011) 1001101
      1011
      1000
```

Step 3

```
      1
1011) 1001101
      1011
     10000
```

Step 4

```
      11
1011) 1001101
      1011
      10000
      1011
```

Step 5

```
      11
1011) 1001101
      1011
      10000
      1011
       101
```

Step 6

```
      11
1011) 1001101
      1011
      10000
      1011
      1011
```

Step 7

```
      111
1011) 1001101
      1011
      10000
       1011
       1011
       1011
```

Step 8

```
      111
1011) 1001101
      1011
      10000
       1011
       1011
       1011
```

(b) (i) In this part students confused *computer-aided design* with *computer-aided manufacture.* Those who understood CAD often could not relate it to the manufacture of integrated circuits.

(ii) A number had an incomplete understanding of the etching process in this part, with many believing it to be a cleaning process. Few understood why the process might be repeated.

(iii) Answers to this part again illustrated the failure of candidates to answer the specific question. Instead of focussing their answer on *precautions to be taken during manufacture to create a dust-free environment*, many students mentioned every precaution about which they had ever heard.

(iv) This was answered correctly by most candidates.

(v) The circuit here was correctly identified by most students but they were unable to explain how the circuit is usually used in computers.

(vii) Many did not identify the *half adder* in part (vii) as a circuit and gave fanciful descriptions. A number of those who did realise it was a circuit were unable to explain its functions clearly.

(viii) Here too many students failed to modify the circuit given in (vi) and simply attempted to draw some half-remembered circuit from class.

(c) In general terms, answers to part (c) were disappointing.

(i) Here candidates failed to answer the question asked and gave advantages of *light* rather than *laser light* or concentrated on a comparison between optical-fibre and some other medium.

(ii) In this part the term *single mode* was not well understood and the diagrams were poorly drawn. Students showed little understanding of the purpose of each layer and simply redrew a remembered diagram.

(iv) This was generally well answered by those who understood the meaning of *technological advantages*. Others failed to relate their discussion of technological (or other) factors to data transmission. Once again, failure to answer the question asked resulted in unnecessary loss of marks.

(v) This part was also poorly answered. Candidates gave answers based on their understanding of other storage media rather than on an understanding of how a magneto-optical disk works.

(vi) This part was reasonably well answered, although many candidates described characteristics of one of the devices only and failed to compare the devices as *storage* devices.

Question 27 : Database Design

Many answers were correct but were far too general in nature and could apply equally well to situations other than the one described in the question.

There appeared to be some difficulty on the part of many students in reading and understanding the scenarios. Terminology once again was not widely known and many who obviously had a reasonable knowledge of the subject did not use the most appropriate terminology in formulating their answers.

(a) Answers to this part perhaps reflected the candidates' own experience with video shops in that their answers tended to be written from a borrower's perspective rather than from that of a student of database design. The question had to be answered in terms of *ethical issues which could cause problems* ***for the video store***. The major problems are ensuring that:

the privacy of the clients is preserved,

the information is kept secure to prevent unauthorised access, although employees still have reasonable access to the data for the efficient carrying out of their jobs.

(ii) Here many answers resembled opinions rather than reasoned statements based on knowledge and understanding of the issues involved. Few students were able to offer a compromise solution which was necessary to obtain full marks.

Again, many students had rote learned definitions without any understanding of the specific term.

(b) That was the case in this part which attempted to assess the candidate's understanding of terms and their definition.

(i) Only here did the question ask for a definition - all other parts required an answer in the candidate's own words.

(c) (i) In this part there were three main alternatives which were equally acceptable provided that the explanation was clear and concise.

- Add an extra field DUEDATE to the BOOK file and link this to the BORROWER file

- Create a third file DUE??? with the fields borrower number, book number and DUEDATE.

- Add multiple extra fields (one per book allowed to be borrowed) DUEDATE to the BORROWER file and link to the appropriate entry in the BOOK file.

(ii) To gain the marks here candidates had to show their understanding. Simply listing all the fields scored no marks. Listing appropriate fields scored part marks. A reason for including the field was essential in order to gain full marks.

Too few students seemed to be aware of what was required in the last part. The major omission was the essential step of performing a query on the database to identify those clients to whom a letter had to be sent, and to select the relevant book information to be provided to the borrower in order to identify the overdue book.

Question 28 : Graphical Techniques

Due to the structure of the question students displayed strengths or weaknesses through either part (a) or part (c).

Including well-labelled diagrams in students' explanations is a procedure which is to be encouraged. Those who did so were often able to explain a process much more clearly than those who used only words.

(a) In this part far too many students failed to see any connection between *raster scanning* and *interlacing* in spite of the wording of part (ii). Of those who could describe interlacing, far too few were able to explain why it is used. Some textbook answers were consistently misquoted because of misinterpretations.

(iii) and (iv) The arithmetical work involved in these parts was well done. Some students, however, despite the wording of (iv), wasted time in evaluating the resultant expression. Usually those who had problems here also had problems in identifying the number of bits required per pixel.

(v) and (vi) Parts (v) and (vi) were not well answered. Many students did not seem to understand the theory behind the generation of *colour/greyscale/monochrome* images.

(b) Here the need to read and answer carefully the question asked was again apparent. Students could state the graphics area studied, but then gave the name of the software used rather than what the *graphics software was used to produce*. Answers to remaining parts were similarly loose and general rather than precise and specific.

Rather than discussing the limitations of the software, most tended to mention **any** limitations such as the speed of the hardware or the paucity of memory.

Candidates often have no idea of the way in which things were done prior to the introduction of computer technology and hence reject questions asking how the use of computer technology compares with the use of *traditional methods*. Very few students could identify the traditional processes in their area of study. Some did not even realise that graphs and graphical images existed before the introduction of computer technology. Those who did attempt to answer this part used the usual generic terms such as *faster, more efficient, easier to change* and so on.

(c) (i) This was very poorly answered as few students knew the term *dithering*, which is the representation of a colour not available in the existing palette by the use of a pattern of other existing colours from which the human eye performs the averaging to achieve the required colour. Among those who did attempt this part there was obvious confusion between *dithering, antialiasing* and conversion between bitmap and vector graphics.

(ii) This part, on the other hand, was well answered, with the better students using clearly labelled diagrams to assist their explanation.

(iii) Most candidates recognised that a paint program is bit-mapped but had difficulty in explaining the problems which would ensue from trying to change the size of the rectangle. Many discussed problems with changing the **triangle**, a term not found in the question.

(iv) Candidates could identify two factors required in this part (selected from *memory size, bus speed/refresh rate* and *number of colours supported*) but were unable to explain the effect of these factors on the resolution of the animation. Many failed to mention the appearance of the animation on the screen. Some wanted to print their animation and discussed the resolution of various printers since the question precluded discussion of the resolution of the monitor.

(v) The majority of candidates answered this part well, although answers were often too general to attract full marks. Responses must refer to the context of the question, hence in this Graphics Option, describing the operation of a modem as a *digitiser* was not awarded any marks.

Many students either did not read the question correctly or simply chose to discuss printers rather than plotters. It is again emphasised that *compare and contrast* requires a discussion of both similarities and differences.

Students are reminded that maximum marks will be given to those who clearly display the most knowledge and understanding of a topic.

Question 29 : Multimedia

(a) (i) Most candidates were able to recall the components of multimedia in answer to this part.

(ii) To obtain full marks here candidates included discussion of wave tables, sampling rates and sample size together with a discussion of both recording and storage. Answers indicated that most students were unaware that there is more than one sound data type.

(b) (i) The term *hypertext* was understood by most students in this part. Quite a few, however, were unable to discriminate between *hypertext* and *hypermedia*.

(ii) The typical middle range answers here were brief - such as *compression and make the video shorter* or *show it in black and white and only show every second frame*. The better quality answers discussed issues such as reducing the resolution of the image, reducing the number of frames in a video,

compressing the video, with the very best answers mentioning a specific compression technique and explaining how it operated. No marks were awarded to answers which mentioned increasing the amount of storage available since the question specifically wanted **methods for reducing the need for storage**.

(iii) This was not an effective discriminator. Most students gained some of the available marks but few gained all because the brevity of their answers prevented them from receiving all of the marks which the candidate's knowledge deserved, e.g. a candidate who wrote *more business* based on his/her view that *the interactive display would cause more interest among the passers-by, attract more people into the store and therefore probably generate more business* could not gain full marks.

Another common error in this type of question was for the candidate to give a disadvantage in one column and then state its opposite as an advantage in the other column. Such answers scored once only. A candidate who states that a disadvantage to the owner of the interactive display would be *less socialising with customers* cannot expect to gain additional marks for stating that an advantage of the non-interactive display would be *more socialising with customers.*

(c) (i) Marks were gained for clarity of design, using a prompt and relating the screen to the information provided. Those who did not gain full marks usually omitted the prompt. The quality of sketches was quite poor even allowing for the fact that they were drawn under examination conditions.

Students must remember that if clarity of design is a desirable attribute then they should ensure that it is incorporated in their answers.

There appears to be considerable confusion as to what constitutes a *storyboard*. Most candidates appeared to understand that it is in a graphic form but few realised the importance of relating the content of the boxes in their storyboard to the information in the question. They often drew up a remembered storyboard instead of applying their knowledge of storyboard construction to the case in point.

Too many students failed to show an understanding of the importance of navigation paths, the need to allow the user to return to the main menu at any time and the need to provide a sensible handling of the map.

The last two parts were the worst answered sections of this question.

(iii) This part allowed for some interpretation of the meaning of *way to select an option*. Those who scored well described a hardware answer such as *use a mouse to click on the choice* or *press a key with the letter of choice*, etc. Others chose to describe the *way to select an option* in terms of the navigational path which needed to be followed.

(iv) The last part was extremely poorly answered. Many candidates made no attempt to create a multimedia solution but simply stated *the store should show a video or play an audio tape*. The better answers looked at software and storage, media which could be used and means of changing the display with minimum effort. It was this latter approach that was sought.

3 UNIT (ADDITIONAL)

1084 candidates presented for this paper, which consisted of:

Section I Twenty multiple choice questions

Section II Two questions, each on one of the compulsory topics.

Section I

The item analysis for Section I follows.

A very small percentage of candidates failed to mark a selection. Question 18 was not attempted by 15 students, which was a significantly larger proportion than for any other question.

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	Choice A		Choice B		Choice C		Choice D	
Item	%	mean	%	mean	%	mean	%	mean
1	15.46	11.5	20.09	10.7	**30.74***	**12.2***	32.87	9.9
2	18.24	9.7	**36.39***	**12.7***	23.70	11.0	20.74	9.1
3	12.13	9.7	3.33	9.99	37.96	10.2	**46.11***	**12.1***
4	5.37	9.1	16.67	8.9	**69.91***	**11.9***	7.78	8.8
5	7.13	8.4	**60.74***	**12.1***	4.07	8.0	27.22	9.7
6	**53.15***	**11.7***	32.78	10.9	7.13	8.8	6.48	8.7
7	17.69	10.8	**57.04***	**11.6***	18.52	10.1	6.57	8.9
8	2.59	7.3	7.96	8.3	18.15	9.2	**71.11***	**11.9***
9	4.63	9.0	**81.20***	**11.5***	3.80	9.9	10.19	8.8
10	12.13	9.9	6.76	8.9	**77.87***	**11.4***	2.96	9.3
11	18.61	10.6	**62.69***	**11.8***	5.37	8.4	13.06	8.7
12	24.26	9.8	**49.44***	**12.4***	13.06	10.3	12.87	8.7
13	29.17	9.5	**50.37***	**12.5***	10.93	9.9	9.07	9.1
14	54.54	10.8	**30.93***	**12.6***	5.00	7.9	9.44	8.9
15	20.00	10.7	6.57	8.8	**46.39***	**12.5***	26.57	9.3
16	8.15	9.3	15.09	9.0	11.02	9.1	**65.37***	**12.0***
17	0.83	7.3	6.02	7.9	**76.39***	**11.6***	16.48	9.4
18	20.46	10.2	17.50	10.7	**35.83***	**12.0***	24.81	10.5
19	12.50	9.5	5.28	8.6	**52.59***	**12.4***	28.98	9.5
20	12.22	10.6	26.94	10.2	14.44	10.1	**45.74***	**11.9***

Note: *Mean* is the average mark on Section I of the students who made that choice.

In all cases the mean mark for those who selected the correct answer was higher than the mean for any of the other choices.

Correct choice is indicated by **bold print** and by *****.

In Question 14 almost half the candidature selected (A). This may be a semantic problem in that (A) is correct **if the line requires a comment**, whereas (B) implies that the line does need a comment and was marked as the *best* choice. Note that the better candidates made the correct choice and that the purpose is to rank candidates.

Question 18 seems to have been answered at random except for the better candidates who **knew** the correct answer.

Section II

Question 21

This question was, on the whole, well answered, particularly parts (b) and (c). Although students wrote a considerable amount in their answers, they must learn to balance their time in producing answers commensurate with the marks available. Even 3 Unit candidates must remember that the regurgitation of rote-learnt definitions **without** relating them to the actual question is unlikely to score maximum marks.

(a) This part was not well answered by the majority of the candidates, although there were some who provided excellent answers. This was one of the questions in which students attempted to use the definitions they had learnt, simply *forcing* them to meet the situation described. Such answers defined things such as *peer-checking*, *test data* and *stubs* which are not relevant to the question. Some candidates did not appear to have learnt the technique of inserting a specific code such as *output statements* which indicate which part of the code is being executed or which displays the value of critical variables to assist with debugging.

(b) This question was reasonably well answered, but some students confused *screen design principles* with *page layout principles* and others confused it with *monitor quality*. Many answers, however, contained another example of rote learning in which a direct quotation from one of the common text books appeared.

The use of diagrams to provide examples of good screen design features was generally poor. Those which were supplied were often untidy and unlabelled, making it difficult to establish what point was being made.

(c) (i) There were a lot of parts here making it difficult for candidates to address each part adequately. Most managed to name the two types of documentation, many identified the major sections, but few got to the stage of outlining the content and justifying its inclusion.

The focus of the question was meant to be on documentation relating to a piece of software. Many students, however, took the broader view and addressed it from a systems perspective, including such items as *data flow diagrams*, *data dictionaries* and *flowcharts*.

(ii) The answers which scored well in this part referred to items such as *online help, interactive tutorials, balloon text, message boxes* and *cue cards*. Those who scored poorly confused online documentation with *internal documentation, intrinsic documentation* and *online help* provided by telephone from a company "Help Desk".

Question 22

The standard of answers to this question was not as high as expected, particularly as there was little challenge beyond the expectations of the 2 Unit Syllabus.

(a) To attract full marks in this part candidates should have provided a well set out desk-check which could be used to determine the source of any errors made by them. Many did not include the desk-check but provided only the output. They did not score any marks if the output was incorrect. Some students did not know how to set out a desk check and produced a tally sheet instead.

Most errors were caused by students not being able to work through the exact operation of the algorithm. Double counting *U* and *O* as both vowels and capitals showed a lack of understanding of the mutually exclusive selection structure of the CASE statement. Counting *m* and *t* as capitals showed a lack of careful reading of the algorithm since these students correctly identified the OTHERWISE clause, but then failed to appreciate the operation of the IF statement. Some students failed to interpret the termination condition of the loop correctly and processed all of the data.

In a few cases students treated the exercise as an English comprehension exercise, made no attempt to desk-check the algorithm but simply wrote down what they thought the output should be.

(b) To attract full marks in this part candidates had to provide nine pairs of test data which included all combinations of a value below, on and above the critical value (boundary value) for each data item, since *age* and *salary* are independent variables. In addition they had to justify the inclusion of each pair.

Many candidates failed to present their data in a logical order, perhaps reflecting their own unmethodical process, and this often resulted in an incomplete set or a set with multiple data pairs representing the same set of conditions.

Some students included values which were more complicated than necessary, such as an age value of 17.99 (equivalent to any integer less than 18) or a salary of $0.00 (equivalent to any salary less than $25 000). Others did not give precise values but, instead, used expressions such as < 18. These scored no marks since the question clearly asked for *a set of test data pairs* which had to be numeric values.

(c) Although there were some creative and ingenious solutions, many candidates might have left themselves insufficient time to complete this part as, overall, the answers were not generally of a very high standard.

Some students did not use meaningful identifiers, which often made it more difficult to determine what the algorithm was achieving. Although students were not penalised for using language-specific naming conventions (such as `A$` or `PLAYER$`) they should be discouraged from doing so in algorithms.

Both approved methods of algorithm description were used but, in general, those candidates who used pseudocode presented a better understanding of the algorithm than those who used flowcharts which were often confused, poorly worded and/or poorly structured. (The opposite was true in the case of 2 Unit candidates (Question 22 of 2/3 Unit (Common) paper).

Too many answers were mere attempts to paraphrase the question; those written in one of the approved methods including statements from the text placed inside an appropriate *box* or with some keywords written in capitals.

In the 3 Unit (Additional) course it is expected that, in the final development of an algorithm, full detail is supplied. For example, asking the question *Is this the last round?*, whilst perfectly adequate in the early stages of development, is not sufficient at the lowest level of detail where the precise means of answering the question needs to be shown (*Is* this-round *equal to* number-of-rounds*?)*

At this level it also necessary for all initialisations to be explicitly incorporated in the algorithm either by setting a variable to its initial value or by reading a value into it. Simply stating *Initialise all variables* is not adequate.

The problem description specifically stated that the algorithm was to accept as input the number of rounds to be played and the *winner* of each round. Many students either ignored the requirement or arbitrarily allocated values. A surprising number of candidates appeared to be unable to accumulate the prize value in the case of a draw.

It is recommended that students develop their algorithms in stages, providing greater levels of detail at each stage of refinement and, where possible, referring specific sub-tasks to an appropriate sub-routine. This allows maximum marks to be gained for the insight into the problem displayed, and for intermediate work should there be errors in the final level of description.