COMPUTING

Paper 9691/11
Written Paper

General comments

The standard of candidates' work was an improvement on last year in many areas.

The format of the examination was similar to June 2013 but the candidates seemed better prepared for this new style of paper than they were twelve months ago. The new format leads candidates and centres gradually into the revised syllabus which has its first sitting in June 2015.

Candidates need to understand that it is no longer the case that simply learning sections from text books will score many marks on future papers. There is a need to understand how to apply their knowledge in new scenarios (both in examinations and in their learning of the subject). This will hopefully give a better grounding of the subject but also enable candidates of all abilities to perform to their full potential in the examination.

Comments on specific questions

Question 1

(a) The grid question was answered well. The question discriminated well with marks from 0 to 4 being achieved. A number of candidates reversed the placing of "ticks" for ROM and hard disk or less common hard disk and flash memory.

(b) There were many correct answers here; although it was fairly common to see the correct answers to parts **(i)** and **(ii)** switched. Very few gave an incorrect response to part **(iii)**.

(c) The benefit most commonly stated was "no moving parts"; although not all candidates went on to say "therefore it is more robust". The majority of candidates, however, just said it was portable and this alone was not a sufficient response as there are many portable storage devices available on the market. A clearer benefit was needed. The most common drawback was its high cost – generally answers such as costs are not allowed since it can vary from country to country. A number also claimed flash memories had a small storage capacity which is certainly not true in 2014. A large number also stated it was easy to lose but gave no reason why; for example because of its small size. Some candidate responses showed a lack of understanding between size and storage capacity.

Question 2

(i)(ii)(iii) Candidates needed to improve their understanding of question part **(i).** A number of candidates referred to circuit switching as turning electricity on or off. Although there were some imprecise answers, the better candidates did score well with "circuit switching involves reserving of a circuit" and "packet switching involves splitting data into packets" being the usual correct answers.

Candidates needed to perform better on part **(ii)**. Candidates needed to improve their understanding of the two terms as most just turned the question back as an answer. Most related base band to LAN and broadband to WAN.

Ring and star networks produced better answers for part **(iii)**. Usually a description was given rather than a diagram, which would have been easier than an explanation. Candidates should be aware that giving a drawing or diagram can often be the best way to answer a question. Some very weak descriptions, for example, "a ring involves computers being connected in a ring" were not regarded as enough for a mark. The star network topology often gained marks because of the reference to central hub/switch or server.

Question 3

(a) Candidates needed to improve their understanding of this question. The airport interface question produced a number of answers referring to: layout left to right, no red green mixes and must be interesting; none of these were relevant to this question. The idea of sound alerts was often given, but without a good reason why sound would be used. Many candidates also confused the interface with the need to talk to pilots. Very few mentioned that the interface needed to be graphical or symbolic in nature to remove any confusion and allow for quick "at a glance" conveyance of information.

(b) Candidates needed to improve their knowledge of parallel and direct changeover methods. In some cases where the correct method was given, very few candidates gave a good reason for the method choice.

(c) The types of maintenance were very well known and many candidates gained high marks. A large number correctly gave both types of maintenance and the majority also described an appropriate situation making it necessary. Some candidates suggested corrective maintenance which was already given in the stem of the question. In adaptive maintenance, a large number mentioned changes in tax law rather than situations directly related to the airport control system.

Question 4

(a) The table mainly generated answers usually worth five or zero marks. A large number of candidates reversed the position of the "ticks". It seems that the words PASS or FAIL were not clearly understood in this question.

(b) This question was generally well answered with many candidates gaining full marks. The only common mistake in part **(i)**, was to use letters and digits not used in the table given at the start of the question. Since it was not known what these letters and digits represented, all the marks were lost in this part.

Question 5

This question was often very well answered by the better candidates. The batch processing answer often defined batch processing rather than referring to the given application requiring real time/immediate feedback. The majority of candidates realised that all programs needed to be written by a programmer at some point. ROM was frequently defined as a read only memory without actually answering the question; this was a common mistake amongst weaker candidates. However, some candidates did indicate that RAM was being described in the question. In the last part, some candidates referred to analogue to digital conversion and omitted to mention the role of a microprocessor or computer in this control application.

Question 6

(a) There were many data structures given here, ranging from LIFO to FIFO, spreadsheets, and a magnetic field. Many candidates lost marks because they just referred to an ARRAY rather than to a 2 dimensional array. The data type was most often missing from many answers.

(b) In part **(i)** many candidates gave a general description of GUI without mentioning the puzzle application as requested in the question. There were many good answers gaining full marks for selecting cells with mouse, touch screen or keyboard and correctly entering numbers 1 to 9 via a keyboard or drop down list.

In part **(ii)**, the idea that the rows/columns should be checked for repeated value or missing values was often stated but it was not always clear that the computer was doing the checking. There was almost no reference to looping (to check all rows and columns) via a program. Many said "compare it to the stored answer" which was too imprecise to gain any credit and a number also referred to validation, verification, checksums, or even using OCR.

Question 7

Candidates needed better understanding of the CAD part of this question. Many candidates did not state a correct feature and also stated a mouse as a CAD input device. The answer was looking for devices such as space mouse, and space ball. The output device was usually a screen or monitor with no reference to its large size. The spreadsheet was the best answered part often gaining three marks. Where candidates lost a mark was usually for just giving printer rather than a type of printer as the output device. The most common presentation software feature that gained no marks was to refer to the "making of slides"; this was not enough for a mark. The idea of including slide transitions, animations and video or sound was often seen in the answers from better candidates. The full range of marks from 0 to 9 was seen in this question.

Question 8

(a) The diagrams in all three parts were usually correct and clearly drawn in many cases. A few candidates drew lines with no gates at all and some drew a flow chart of decisions. It was still common to see single input AND gates and OR gates. Candidates made their answers clearer by naming the gates which is a good idea. It is worth pointing out here that the new syllabus will require the correct logic symbols to be used rather than the circles or boxes used by some candidates.

(b) The truth table was very well answered with many gaining full marks.

Question 9

(a) This question was generally well answered, but some candidates unfortunately reversed the binary number when completing the register.

(b) This question was well answered. Although some candidates needed to improve their understanding of how to convert from binary to denary as they gave inaccurate drink options.

(c) The idea that an error message would be produced was a very common, correct answer. Some candidates stated that the vending machine would not give out a drink or calculated the number wrongly and stated the type of drink served.

(d) This was generally well answered; although a number of candidates did reverse the 0 and 1 in the two boxes.

(e) This question proved to be a good discriminator with the full range of marks from 0 to 3 seen. Many candidates circled the bit in the correct column but in the wrong byte (i.e. in the wrong row). Some candidates appeared to think that the parity bit sets the row/column to odd or even i.e. if it is a 1 then the row/column should have an odd number of data bits; this is incorrect. In some cases where candidates identified the correct intersection of row and column, a number then stated it was the parity bit in the parity that was wrong, not the intersecting bit.

COMPUTING

Paper 9691/12
Written Paper

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(b) In part **(i)** many candidates gave a general description of GUI without mentioning the puzzle application as requested in the question. There were many good answers gaining full marks for selecting cells with mouse, touch screen or keyboard and correctly entering numbers 1 to 9 via a keyboard or drop down list.

In part **(ii)**, the idea that the rows/columns should be checked for repeated value or missing values was often stated but it was not always clear that the computer was doing the checking. There was almost no reference to looping (to check all rows and columns) via a program. Many said "compare it to the stored answer" which was too imprecise to gain any credit and a number also referred to validation, verification, checksums, or even using OCR.

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(e) This question proved to be a good discriminator with the full range of marks from 0 to 3 seen. Many candidates circled the bit in the correct column but in the wrong byte (i.e. in the wrong row). Some candidates appeared to think that the parity bit sets the row/column to odd or even i.e. if it is a 1 then the row/column should have an odd number of data bits; this is incorrect. In some cases where candidates identified the correct intersection of row and column, a number then stated it was the parity bit in the parity that was wrong, not the intersecting bit.

COMPUTING

Paper 9691/13
Written Paper

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Comments on specific questions

Question 1

The full range of marks from 0 to 5 was seen here. Candidates who drew more than one line from some of the left hand boxes cancelled out any mark they might have gained.

Question 2

(a) Candidates needed to improve their knowledge for this question. Buffers and interrupts were often described as definitions rather than applied to the actual question. Many candidates described interrupts as only happening when the printer is out of ink/paper and some suggested that it signalled the user. A number of candidates stated that it was the hard disk that sends the data to the buffer. Some candidates answered the question in terms of printer queues which was clearly an answer to a question asked on a previous paper.

(b) The difference between serial and parallel is generally well known. Candidates needed to use the term cable rather than wire. Many candidates also confused serial/parallel with simplex and duplex; again the answer from a previous paper.

Question 3

(a) The fact finding question was well answered on the whole. Candidates needed to give interview as the technique instead of group discussion. The idea of questionnaires was also quite weak since the candidates did not mention creating the questions prior to handing the paper out; they only referred to answering a lot of questions.

(b) Candidates needed to improve their knowledge of data flow diagrams (DFD) and system flowcharts. Mentioning symbols and using diagrams would have supported their answers.

(c) The contents of technical documentation was often well known with system purpose, hardware/software requirements, programming code and finally variable lists being the most common correct answers. Some candidates needed to improve their understanding of this question as they clearly referred (incorrectly) to user documentation and gave answers like: frequently asked questions, how to install the software and how to save/print documents.

Question 4

(a) This question was generally well answered. Some candidates did need to improve their knowledge of the difference between input devices and output devices as they stated printers, loud speakers and monitors as input devices.

(b) Candidates needed to improve their understanding of this question. It was common to see answers that claimed the item was scanned rather than the barcode. Once scanned the idea of the barcode acting as a key field was rare to see and even rarer was the idea of using this to search the stock database. Few candidates mentioned the idea that the field with the stock total would be decremented by 1 for each item sold. The majority of answers were imprecise and just stated that the total would be decremented. There was much discussion of how a barcode is scanned, black white line reflecting, which did not really answer the question asked. Very few candidates mentioned setting a flag when new stock had been ordered.

(c) In part **(i)**, batch processing, as not involving human interaction, was the most common answer seen. Very few candidates mentioned the two ideas of collecting the data first and then processing the data in one go.

Batch processing used to process a payroll, often gained good marks especially where candidates stated that large amounts of data of a similar nature were processed (mention of not time sensitive was occasionally stated here as well). However, candidates who just stated so workers get paid gained no credit.

Question 5

(a) Candidates needed to improve their knowledge for this question. Many did not state that the magnetic stripe gets read by the device. A familiar response was “OCR scans the face or photograph”. Many also compared the scanned photograph to something stored in the computer and did not refer to an image of the person’s face.

In part **(ii)**, there were many correct answers given which were clearly described. In some cases, incorrect answers for validation checks included range, checksum or presence check.

(b) Many answers about what extra security could be considered did not state anything new. It was, however, common to see finger/thumb print scanners and password/PIN numbers should be entered. Good answers would also refer to the use of hologram security devices to improve security.

Some candidates suggested that the card/use should be removed from the database if the card was lost or stolen. Whilst this would work to some extent, it would not guard against cards stolen without the user knowing until it was perhaps too late (e.g. if they had gone on two weeks holiday).

Question 6

(a) Candidates needed to improve their understanding of this question. Candidates needed to improve their knowledge of CLI. Often a GUI used a mouse but there was no mention of icons to represent applications or the use of a “windows” environment.

(b) Candidates needed to improve their understanding of this question. Some answers were imprecise, for example, “CLI used by people who know how to use computers” and “GUI used by people who do not know how to use computers”. CLI is used by programmers or systems engineers (since they need to communicate at system level) and GUI is used by the end user (so they can easily launch applications by clicking on an icon).

(c) Candidates needed to improve their understanding of this question. Very often the answer given would mention blind users and talk of natural language interface with no details. Often the words microphone and speakers were given with no indication of how these would be used to help the disabled person. Voice recognition was a reasonably common correct response. Braille keyboards were also mentioned as a type of interface to help blind or partially-sighted people. Colour blindness was mentioned often and is not really valid. Deafness was also stated, which would probably not require any interface changes.

In some cases, marks were lost by candidates as they did not mention which disability was being catered for (this point was clearly stated in the question itself).

Question 7

(a) This part of the question was well answered.

(b) Part **(i)** was well answered, although the zero value was chosen by some candidates.

In part **(ii)**, the idea of parity seems well known but most candidates gave definitions rather than how it works. Many simply wrote: “check the parity bit” but did not indicate how this was done. Relatively few mentioned add/count the number of 1’s in the received byte. Many candidates stated that the number of 1s or 0s was counted; this method would not work in all cases.

(c) In part **(i)**, often the correct bit was circled but the candidate did not draw the arrow pointing to the byte in error. Many candidates circled the digit in the correct column but chose the wrong byte (row); often bits in the parity byte were circled.

The second part was often incorrect, especially if the candidate had chosen the wrong byte in the first place.

In part **(iii)**, many candidates just suggested that the data is re-sent; this was not enough to gain a mark. Few candidates mentioned the idea of a checksum and even fewer stated how such a system would be carried out. There was much reference, however, to the user doing the checking.

Question 8

(a) This question was well answered with many candidates scoring high marks. It was good to see candidates using the working column in the truth table, this enabled Examiners to see how the candidate arrived at their answer.

(b) The diagram was frequently correct and clearly drawn in a large number of cases. A few candidates drew lines without any gates at all and some drew a flow chart of decisions. It was still common to see single input AND gates and OR gates. Candidates made their answers clearer by naming the gates which is a good idea. A number of candidates used a NAND gate to replace the AND gate (which has two NOT gates as input) – this is a common misunderstanding which does not give the same result.

It is worth pointing out here that the new syllabus will require the correct logic symbols to be used rather than the circles or boxes used by some candidates

Question 9

(a) Most candidates gained 2 or 3 marks here; the most common mistake was the *current floor level* (value 45); this was clearly due to an incorrect conversion from binary to denary. Some candidates wrote the answer in binary; candidates need to ensure that they read the question carefully.

(b) This question was generally well answered. The majority of candidates seemed to understand the concepts outlined in the question.

(c) Some really good answers were seen for part **(i)** where the candidate clearly indicated that they understood the logic behind the lift sequencing.

Many candidates correctly identified lift “C” in part **(ii)** as the most appropriate lift to be chosen. Usually, candidates who did well in part **(i)** did well in the second part as well.

(d) Candidates needed to improve their understanding of this question. Many candidates just stated that the lift stops at floor 28 38 40 etc. There was no mention of sorting the data into ascending order. No candidate suggested what would happen to the floor list if a new person got into the lift. Many candidates simply put the data into a list and others mentioned FIFO or LIFO lists which again would not work. Responses to this question indicated that candidates need to improve their knowledge of basic data handling skills.

COMPUTING

Paper 9691/21
Written Paper

Key Messages

To succeed in this paper it is essential that candidates have practical experience of programming using a high-level procedural language. It is recommended that candidates choose one of the following: Pascal, Visual Basic (console mode), and Python.

Programming and pseudocode questions from past examination papers provide an ideal starting point for practical work.

General Comments

This year, a distinct improvement in writing programming code and pseudocode was noted. Candidates need to understand that pseudocode statements are different to programming language statements. Candidates are expected to be able to write the equivalent programming statements in their chosen programming language.

There are still many candidates who do not appear to have any programming experience.

Comments on Specific Questions

Question 1

(a) (i) Most candidates showed buttons with the numbers 1 to 10 for the user to select the chosen multiplication table. Some candidates needed better understanding of the question as they did not note that this was the design of the initial screen and therefore that it required a suitable heading. Candidates need to improve their knowledge of screen designs and include explanations as to what the shapes represent. For example, are the boxes with numbers just labels or are they control buttons? Drop down lists and combo-boxes were sometimes used, but candidates needed to show their knowledge by labelling these clearly. A method for moving on from the initial screen was also required. Many candidates included Help and Cancel buttons, but Next or equivalent buttons were often omitted.

(ii) Most candidates explained that the user would touch the number button using a touch screen or click on the number using a mouse.

(b) Some candidates gave excellent solutions using their chosen programming language. Weaker candidates reused the pseudocode keywords from the flowchart, which is not appropriate. Candidates need to be able to form assignment, selection and iteration statements correctly according to their programming language.

For example the flowchart box containing

`Result ← i * Number`

should be implemented as

`Result := i * Number;` (in Pascal)

`Result = i * Number` (in Visual Basic)

(c) Most candidates were able to complete the pseudocode for the nested `FOR` loop. The better candidates included the `Newline` required between the inner and outer loop.

(d) Most candidates were able to complete the flowchart correctly. Some of the weaker candidates needed to improve their knowledge of what the different shaped boxes in the flowchart represent. Rectangles represent processes, diamond shapes represent selection and parallelograms represent input/output.

Question 2

(a) Most candidates made a good attempt at this question. Some candidates needed to improve on their knowledge as they did not know that a function header needs to state the data type of the result to be returned. Candidates need to understand the difference between the = symbol (equivalence) and the ← symbol (assignment) in pseudocode. Although some programming languages use the = symbol for both of these concepts, the distinction between these concepts is fundamental.

(b) (i) Candidates needed to improve their knowledge of how to declare integer and string arrays using their chosen programming language.

(ii) Most candidates had some knowledge of how to declare a record type in their chosen programming language. The errors seen in these declarations suggest that some candidates only have theoretical knowledge, and need more experience of writing and executing programs using record types.

(iii) Candidates needed to show better understanding of this question. Most candidates seemed unaware that the record type from part **(ii)** could be used just like any other built-in data type to declare an array of records.

(iv) The better candidates were able to write the required statements to assign the given values to the two fields of the third element of the array `Student`.

(c) Most candidates understood that they needed to write a procedure and gave a procedure header. Some candidates needed to improve on their knowledge for this question and also give a procedure ending. The better candidates wrote the appropriate programming statements using a loop to access each array record in turn and write it to the file previously opened, and finally closed the file.

Question 3

(a) (i) Some candidates noticed that a function that was required to return an array index would need to show in the function header, that it returns an `Integer` data type. Most candidates realised that it required a loop to check each stored name. Some candidates needed to improve on their knowledge for this question, as few were able to write the required expression to check the names:

```
IF student[i].Name = ChildName THEN …
```

A number of candidates checked a file rather than the required array. Few candidates used a conditional loop that terminates when the name was found. Instead, many candidates used a `FOR` loop which they then exited from prematurely. This is not an appropriate use of a `FOR` loop. The better candidates offered the most concise solution:

```
i ← 0
REPEAT
   i ← i + 1
UNTIL student[i].Name = ChildName
```

(ii) Most candidates provided a solution by introducing a Boolean variable `Found`, set to `FALSE` initially, and set to `TRUE` if the name was found. Some candidates needed to improve on their knowledge and explain that if the whole array had been checked and `Found` was still `FALSE`, that the return value would need to be an integer value that was not a valid array element (for example -1). It is not appropriate to output a message to the user from the function.

(b) Most candidates correctly stated that all the names entered should be converted to the same case (all upper case or all lower case). Some candidates needed to improve on their knowledge and understand that strings are stored in the computer as ASCII codes and that the upper case of a letter had a different ASCII code to the lower case of the same letter. For example, the code stored for 'A' is different to the code stored for 'a'.

Question 4

(i) Most candidates knew that a recursive function is one that calls itself.

(ii) Candidates found the dry-running of this recursive function challenging. Most candidates made a good attempt, but very few had a suitable method for showing the unwinding of the recursive calls.

The following trace table shows clearly how control returns to previous function calls, continues with the execution (evaluation of `LEFT(s,1)`) and returns the result to the calling code.

Call Number	Function call	s	x	RIGHT(s,x - 1)	LEFT(s,1)	Return value
1	Y('BYTE')	'BYTE'	4	'YTE'		
2	Y('YTE')	'YTE'	3	'TE'		
3	Y('TE')	'TE'	2	'E'		
4	Y('E')	'E'	1			'E'
(3)					'T'	'ET'
(2)					'Y'	'ETY'
(1)					'B'	'ETYB'

(iii) Few candidates were able to state that the function reverses the string passed as parameter.

(iv) Most candidates noted that comments and indentation were the features of the given pseudocode that made it easier to understand.

(v) The most common correct answer to this question part was not using meaningful variables.

(vi) Most candidates took the hint of "iterative function" and produced a loop. Fewer candidates removed the recursive call from the pseudocode. There were many possible correct answers. One method is shown below.

```
FUNCTION Y(s: STRING) RETURNS STRING
   NewWord ← ""                        // empty string
   WordLength ← LENGTH(s)
   FOR i ← 1 TO WordLength
      Letter ← MID(s,i,1)
      NewWord ← Letter + NewWord
   ENDFOR
   RETURN NewWord
ENDFUNCTION
```

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(a) (i) Most candidates showed buttons with the numbers 1 to 10 for the user to select the chosen multiplication table. Some candidates needed better understanding of the question as they did not note that this was the design of the initial screen and therefore that it required a suitable heading. Candidates need to improve their knowledge of screen designs and include explanations as to what the shapes represent. For example, are the boxes with numbers just labels or are they control buttons? Drop down lists and combo-boxes were sometimes used, but candidates needed to show their knowledge by labelling these clearly. A method for moving on from the initial screen was also required. Many candidates included Help and Cancel buttons, but Next or equivalent buttons were often omitted.

(ii) Most candidates explained that the user would touch the number button using a touch screen or click on the number using a mouse.

(b) Some candidates gave excellent solutions using their chosen programming language. Weaker candidates reused the pseudocode keywords from the flowchart, which is not appropriate. Candidates need to be able to form assignment, selection and iteration statements correctly according to their programming language.

For example the flowchart box containing

`Result ← i * Number`

should be implemented as

`Result := i * Number;` (in Pascal)
`Result = i * Number` (in Visual Basic)

(c) Most candidates were able to complete the pseudocode for the nested `FOR` loop. The better candidates included the `Newline` required between the inner and outer loop.

(d) Most candidates were able to complete the flowchart correctly. Some of the weaker candidates needed to improve their knowledge of what the different shaped boxes in the flowchart represent. Rectangles represent processes, diamond shapes represent selection and parallelograms represent input/output.

Question 2

(a) Most candidates made a good attempt at this question. Some candidates needed to improve on their knowledge as they did not know that a function header needs to state the data type of the result to be returned. Candidates need to understand the difference between the = symbol (equivalence) and the ← symbol (assignment) in pseudocode. Although some programming languages use the = symbol for both of these concepts, the distinction between these concepts is fundamental.

(b) (i) Candidates needed to improve their knowledge of how to declare integer and string arrays using their chosen programming language.

(ii) Most candidates had some knowledge of how to declare a record type in their chosen programming language. The errors seen in these declarations suggest that some candidates only have theoretical knowledge, and need more experience of writing and executing programs using record types.

(iii) Candidates needed to show better understanding of this question. Most candidates seemed unaware that the record type from part **(ii)** could be used just like any other built-in data type to declare an array of records.

(iv) The better candidates were able to write the required statements to assign the given values to the two fields of the third element of the array `Student`.

(c) Most candidates understood that they needed to write a procedure and gave a procedure header. Some candidates needed to improve on their knowledge for this question and also give a procedure ending. The better candidates wrote the appropriate programming statements using a loop to access each array record in turn and write it to the file previously opened, and finally closed the file.

Question 3

(a) (i) Some candidates noticed that a function that was required to return an array index would need to show in the function header, that it returns an `Integer` data type. Most candidates realised that it required a loop to check each stored name. Some candidates needed to improve on their knowledge for this question, as few were able to write the required expression to check the names:

```
IF student[i].Name = ChildName THEN …
```

A number of candidates checked a file rather than the required array. Few candidates used a conditional loop that terminates when the name was found. Instead, many candidates used a `FOR` loop which they then exited from prematurely. This is not an appropriate use of a `FOR` loop. The better candidates offered the most concise solution:

```
i ← 0
REPEAT
   i ← i + 1
UNTIL student[i].Name = ChildName
```

(ii) Most candidates provided a solution by introducing a Boolean variable `Found`, set to `FALSE` initially, and set to `TRUE` if the name was found. Some candidates needed to improve on their knowledge and explain that if the whole array had been checked and `Found` was still `FALSE`, that the return value would need to be an integer value that was not a valid array element (for example -1). It is not appropriate to output a message to the user from the function.

(b) Most candidates correctly stated that all the names entered should be converted to the same case (all upper case or all lower case). Some candidates needed to improve on their knowledge and understand that strings are stored in the computer as ASCII codes and that the upper case of a letter had a different ASCII code to the lower case of the same letter. For example, the code stored for ‘A’ is different to the code stored for ‘a’.

Question 4

(i) Most candidates knew that a recursive function is one that calls itself.

(ii) Candidates found the dry-running of this recursive function challenging. Most candidates made a good attempt, but very few had a suitable method for showing the unwinding of the recursive calls.

The following trace table shows clearly how control returns to previous function calls, continues with the execution (evaluation of `LEFT(s,1)`) and returns the result to the calling code.

Call Number	Function call	s	x	RIGHT(s,x - 1)	LEFT(s,1)	Return value
1	Y('BYTE')	'BYTE'	4	'YTE'		
2	Y('YTE')	'YTE'	3	'TE'		
3	Y('TE')	'TE'	2	'E'		
4	Y('E')	'E'	1			'E'
(3)					'T'	'ET'
(2)					'Y'	'ETY'
(1)					'B'	'ETYB'

(iii) Few candidates were able to state that the function reverses the string passed as parameter.

(iv) Most candidates noted that comments and indentation were the features of the given pseudocode that made it easier to understand.

(v) The most common correct answer to this question part was not using meaningful variables.

(vi) Most candidates took the hint of "iterative function" and produced a loop. Fewer candidates removed the recursive call from the pseudocode. There were many possible correct answers. One method is shown below.

```
FUNCTION Y(s: STRING) RETURNS STRING
   NewWord ← ""                        // empty string
   WordLength ← LENGTH(s)
   FOR i ← 1 TO WordLength
      Letter ← MID(s,i,1)
      NewWord ← Letter + NewWord
   ENDFOR
   RETURN NewWord
ENDFUNCTION
```

COMPUTING

Paper 9691/23
Written Paper

Key Messages

To succeed in this paper it is essential that candidates have practical experience of programming using a high-level procedural language. It is recommended that candidates choose one of the following: Pascal, Visual Basic (console mode), and Python.

Programming and pseudocode questions from past examination papers provide an ideal starting point for practical work.

General Comments

This year, a distinct improvement in writing programming code and pseudocode was noted. Candidates need to understand that pseudocode statements are different to programming language statements. Candidates are expected to be able to write the equivalent programming statements in their chosen programming language.

Comments on Specific Questions

Question 1

(a) (i) Most candidates correctly identified that the data type for the loop control variable needed to be Integer. Fewer candidates realised that it required a real number to store the result of a conversion where the given conversion factor was a real number.

(ii) Many candidates were able to complete the pseudocode for a FOR loop. The better candidates also completed the two assignment statements correctly. Candidates with practical programming experience performed well on this task.

(b) (i) Most candidates gave the correct results for the DIV and MOD operators.

(ii) Candidates needed to improve on their knowledge for this question and be able to calculate whether there were an exact multiple of 6 eggs. Most candidates correctly wrote the pseudocode to increment the number of boxes. However, candidates needed to understand that the parameter NumberOfEggs did not need to be declared as a local variable, but NumberOfBoxes did need declaring.

(c) Many candidates knew that a function always returns a single value and a procedure may return none, one or many values.

(d) The most frequent correct answers listed annotations, indentation and the choice of meaningful identifiers. Candidates need to understand that parameters and local variables also aid maintainability of programs.

Question 2

(a) (i) Most candidates included in their screen layout the essential features to gather the required data. Some candidates did not show text boxes to enter names and telephone numbers, only a single line. This is not sufficient to represent input boxes. The facility to enter a date needed more than a text box to aid unambiguous input data. Drop-down boxes and radio buttons were the most popular features used to gather the cake choices and delivery option. Candidates needed better understanding of what was required for delivery choice.

(ii) Few candidates were able to justify why they had used drop-down boxes, radio buttons, check boxes or calendar controls. Candidates need to improve their knowledge of these methods and be aware that these methods are used to minimise erroneous data entry, and not just to make it easy for the user.

(b) (i) Most candidates identified the correct data types for CustomerName, DateReady, Price and ToBeDelivered. Fewer candidates took note of the information given in the question: that CakeType was a single character. Candidates need to understand that TelephoneNumber is called a number but must always be stored as a string.

(ii) Many candidates had some knowledge of how to declare a record type in their chosen programming language. Candidates need to improve on their practical knowledge as the errors seen in these declarations, suggest that many candidates only have theoretical knowledge and have not tried to write and execute programs using record types.

Question 3

This question required candidates to translate a flowchart into program code of their chosen programming language. Candidates needed to improve their understanding of this question, as many copied the text from the flowchart boxes and made it appear as a program. Candidates need to appreciate that pseudocode given in examination questions uses the ← symbol to show assignment. This needs to be converted to the relevant assignment symbol. For example, this is: = in Pascal and = in all Visual Basic versions. Similarly, conditional statements, loops, and input and output statements, need to be converted to the relevant statements. Practical programming experience was clearly evident in some candidates' answers.

Question 4

(a) The most frequent correct answer was Graphical User Interface (GUI) using a touch screen. Other responses illustrated that candidates needed to improve their understanding of what menu-based and form-based interfaces are.

(b) (i) Most candidates knew that a 2-dimensional array is required to store the puzzle.

(ii) Candidates needed to improve their knowledge of writing a statement to assign a value to a single cell in the array.

(c) Candidates needed to improve their understanding of this question and study the given information more carefully. The information clearly stated that the character entered by the user is stored in a character variable. Therefore, the Boolean expression to check whether this character is a digit needs to read:

```
Entry >= "0" AND Entry <= "9"
```

Candidates need to appreciate that the digits need to be enclosed in quotes to show they are treated as characters.

(d) There were some good answers here showing that some candidates are able to problem solve. Many candidates suggested using a stack because this was a Last-In-First-Out data structure and the "Undo" operation would require the last entry to be deleted. Fewer candidates could give a more detailed description of how the entry would need to be stored, such as, that the x- and y-coordinates of the puzzle needed to be stored where a number had been entered.

Question 5

(i) Most candidates were able to dry-run the FOR loop part of the pseudocode. The better candidates realised that the inner loop had to be completed for each time through the FOR loop. These candidates also completed the contents of the List elements and were in a better position to answer the next part of the question.

(ii) Some candidates realised that this pseudocode was a standard insertion sort and could answer this part, even when they had not fully answered **part (i)**.

COMPUTING

Paper 9691/31
Written Paper

General

There was evidence of an improvement in candidate responses for some areas of weakness highlighted in previous reports. This included the completion of the pseudocode algorithm given in **Question 4 (d)(ii)**. This was also true for the question parts in **Question 2** where a working knowledge of some data manipulation language commands was expected. This was the first paper where knowledge of commands which perform maintenance of some kind on the data was asked for; **Question 2 (f)** was updating an existing entry in one of the database tables. This improvement is best progressed by exposing candidates to some practical work with a database prepared and made available by the teacher together with a software tool which allows the interrogation of the data by the candidate.

Question 1

In part **(a)** most candidates were able to identify rule 4 as recursive. Candidates do need to improve their understanding of BNF rules as the explanation often did not gain the first mark because candidates described procedures and functions (from high-level language programming) and not BNF rule definitions.

For part **(b) (i)** an explanation was looked for; not just a list of rules used, as in previous examination questions. The sequence had to be explained that; 8 is a digit, but an integer can be a digit, hence the given string satisfied the 'left bracket – integer – right bracket' given for the definition of an array subscript.

For part **(b)(ii)** most candidates scored the mark by stating that the given string did not end with a right bracket.

Part **(c)** was intended to be more demanding. There were some marks which were accessible by all candidates. Most answers realised that the distinction must be made between the non-zero and all digits. There were variations on this, with the two most popular answers defining either: new rules for a zero and non-zero digits or, non-zero digits and all of the digits.

The majority of answers retained the original rule 5, and so secured a third mark. The challenge was then to re-define <Integer> and this often needed further understanding. The common mistake was a new rule for <Integer> which still allowed the array subscript digit(s) to start with a zero.

Question 2

Candidate answers to part **(a)** needed further development, with very few stating that the issue here was that the table was not in First Normal Form. The expected explanation of a 'repeated group of attributes' was often weak. Some candidates exposed their lack of understanding by stating that the Vehicle Type value was repeated for several of the records.

Part **(b)(i)** was well answered.

Candidates needed to improve their knowledge for part **(c)(i)** as a common weakness was to deduce that the relationship was 'one-to-many' and so required the addition of an intermediary table.

Part **(c)(ii)** was well answered with many clear descriptions stating that the primary key of the Customer table (CustomerID) would be used as a foreign key in the Hire table.

Answers to part **(d)** were varied. The two points looked for were that the query will output a list of registration numbers for all vehicles currently on hire. Weak answers did no more than describe the attributes used in the WHERE clause.

Most candidates scored for part **(e)**. Common mistakes were the inclusion of a keyword AND between the depot town and registration number attributes and the use of the wrong table (both of which were penalised).

Most candidates scored at least one mark for the final part **(f)**. As the earlier rubric did not specify the data type used for Licence Checked, the marking was flexible about the value the candidate assigned. Answers which used either the Date Booked or Date Hired were given credit.

Question 3

For the logic programming question, most candidates scored for parts **(a) (i)** and **(ii)**. Part **(iii)** was less well answered. The output will display the player names only, and a common imprecise answer was to show output of the names and ages (which was penalised).

The most considered correct answer for part **(iv)** was to state that the condition will return FALSE. The marking did credit a wide range of answers which conveyed the understanding that there would be 'no output'.

Part **(b)** and **(c)(ii)** proved to be good discriminators. Several logic programming questions have appeared on previous papers and candidates should be aware that the convention is to show all data values and clause names starting with a lower case letter. The most common imprecise answer was to show the player names (for the two new Player clauses) starting with a capital letter A and this was penalised once. The most popular answers stated new clauses for team, team Gender and player (x2) but omitted a clause for age Limit.

For the final part **(c)** candidates realised that a check needed to be made on the age and many secured the full four marks.

Question 4

Part **(a)(i)** was intended to assess the candidate's use of basic tree terminology. Many did not follow the instruction of "drawing a line around the left subtree". Candidates also needed to improve their understanding of the use of the terminology 'leaf node'.

Answers to **(b)** and **(c)** were weak with very few candidates securing full marks. The most common mistake in the identifier table was to define the root pointer as an array. For part **(c)**, the most common marks awarded were to candidates who realised that the root pointer had value 1 and the additional names would be added to the array table in order of arrival (not alphabetical order). Answers for the correct pointers were rarely seen.

A common incorrect response for part **(d)(i)** was 2, with candidates not realising a comparison needed to be made with the LION node in order for it to be found.

Answers for the completion of the pseudocode were good. Candidates need to be rigorous in their use of the 'equals' and the 'assignment operator'. A common mistake was to use the assignment operator in the UNTIL condition and/or the IF statement and this lost marks.

Question 5

Candidates' performance across the various number/data representations was varied. Candidates needed to improve their understanding of BCD. A common response for **(a)** was the correct calculation of Byte 1 as 97 but then candidates were not able to calculate the negative number for Byte 2.

For the real number calculation in part **(d)** there were very few answers which incorrectly used a base of 10 (unlike in previous papers) and many correct answers of 6.5 were seen.

For parts **(d)(ii)** and **(e)(i)** a precise answer was required. There were many responses starting with *'it ……..'* and this did not secure the mark. An answer which stated that the first digit of Byte 7/the mantissa/the 16-bit pattern is a zero bit was required. A similar clarity was required for the 'normalised' explanation. Many answers incorrectly described a condition which must be present in both bytes.

Part **(e)(ii)** proved to be challenging for the majority of candidates. Candidates rarely scored more than one mark (usually for a correct mantissa for the first pattern).

The final part **(f)** was well understood.

Question 6

This was a different question framework for the assessment of this area of the syllabus and candidates produced strong answers. Descriptions of a LAN often did not score the two marks. Two key points were looked for; that we have a set of connected computers which are situated in a small geographical area (best illustrated with an example, such as the home, an office or within the same building). Some incorrect answers suggested it was always a wireless network.

For part **(b)**, the popular answer was the use of passwords. It was anticipated that the candidate might then suggest that the hardware to implement this would be domain controller or file server. Some answers interpreted the question rubric as 'restricted access from the outside' and so gave a firewall as their answer which was given credit.

The three answers given for part **(c)** were optic fibre, coaxial and twisted-pair and the descriptions were good. Candidates were usually able to come up with two different and relevant benefits for each chosen type.

For part **(f)**, candidates were expected to take note of the reference to 'millions of transactions' in the question and then make their choice of hardware and software. Database software was not considered appropriate. An application like this would require Database Management System software. The consequent hardware would be a database server (although weaker answers such as a file server or a large volume of hard disc storage, were given credit). For the third mark, the most popular answer was a web browser for the 'client software' available to staff.

Question 7

Candidates needed to improve their understanding of computer simulation. Two key points were looked for in the description but candidates rarely secured both marks.

Popular answers for the additional sensors were for humidity, wind speed or a light sensor.

Part **(c)** required only one key difference. Answers which scored the mark described the flight simulation as a real-time system, or that the flight simulator required the building of a physical piece of equipment controlled by sensors and actuators.

COMPUTING

Paper 9691/32
Written Paper

General

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COMPUTING

Paper 9691/33
Written Paper

General

There was evidence of an improvement in candidate responses for some areas of weakness highlighted in previous reports. This included the question on object-oriented programming. The use of a class diagram was well understood and the completion of an object diagram (examined for the first time) was well answered. This was also true for the question parts in **Question 2** where a working knowledge of some data manipulation language commands was expected. This was the first paper where knowledge of commands which perform maintenance of some kind on the data was asked for; **Question 2 (e)** was updating an existing entry in one of the database tables. This improvement is best progressed by exposing candidates to some practical work with a database prepared and made available by the teacher together with a software tool which allows the interrogation of the data by the candidate.

Question 1

In part **(a)** most candidates were able to identify rule 4 as recursive. However, the explanation often did not gain the first mark, as candidates described procedures and functions (from high-level language programming) and not BNF rule definitions.

Candidates scored well for part **(b)**. The question did not require an explanation of the rules used only the rule numbers.

For part **(c)** what was expected were rules as follows; first a rule which defined the terminal character <underscore>. Then a definition for a constant could be expressed using the existing rule for <VarName> as <Constant>::=<VarName><Underscore>

Question 2

This was a more complex data model than seen on previous examination papers, but the candidates were given the partially completed E-R diagram. Part **(a)** was well answered with most candidates able to score at least three of the available marks for **(a)(ii)**. A common weakness was to include reference to one or more paintings in the Exhibition table and this was penalised. A correct composite primary key of ExhibitionTitle + Painting Reference No was rarely seen for part **(b)(i)**.

Parts **(c)** and **(d)** were well answered. A common loss of a mark was either showing just a single attribute in the SELECT clause or the inclusion of the keyword AND between the attributes.

Candidate answers for the DML scripts showed improvement for queries (parts **(c)** and **(d)**) and for the writing of a DML command which maintains the data in a table (Part **(e)**). Candidates need to be competent with similar scripts for the addition and deletion of one or more records in a table.

Question 3

Most candidates scored highly with the completion of the class diagram for part **(c)(i)**. The attributes were shown for the correct subclasses with an appropriate data type. However, few candidates realised that wording the rubric, *"a list of …."* for both the sports played and team names, was intended to draw the understanding that an array or list would be required in the data definition.

The object diagram for the final part was well answered. A common weakness was to omit 'national team' from the list of team names in the Stadium subclass.

Question 4

Candidates need to develop their understanding for this question. Few candidates gained maximum marks for the completion of the identifier table. Common mistakes were to suggest that the RootPtr value required an array. Conversely, answers for the definition of Data omitted the array and defined its data type simply STRING.

Answers for the completion of the trace table were good.

Answers for part **(c)** were variable. A common result was to score two of the available four marks; a correct root pointer of 1 and the data values correctly entered into the array table in order of arrival.

Question 5

Candidates scored well on this question. Some candidates did need to improve their understanding of Binary Coded Decimal (BCD), as they had answers which were not four digits. For part **(d)** many correct answers were seen. A common mistake for weaker candidates was to show the mantissa as an integer.

For part **(d)(ii)** a precise answer was required. There were many responses starting with *'it ……..'* and this did not secure the mark. An answer which stated that the first two digits of Byte 7/the mantissa/the 16-bit pattern is a zero bit was required. Some answers incorrectly described a condition which must be present in both bytes.

Answers to part **(d)(iii)** required the candidate to put into practice the theory they had described for part **(d)(ii)**. Similarly, many candidates scored the two available marks for part **(iv)**, showing the largest normalised positive mantissa and the largest positive exponent.

Answers for the final part **(e)** were good with candidates stating that there would be a loss of accuracy and an increased range in the numbers which can be represented.

Question 6

Candidates needed to improve on their sketch of the LAN topology. Although, it was appreciated that the candidate was required to be a little resourceful in deciding what hardware was required. The basics which would be required of any LAN, which was to be used by a number of users, would be the main single cable run, cable terminators, computers and a file server. Candidates who drew and labelled the diagram would have scored three of the five available marks. A printer would have secured a mark. The final consideration for the candidate should have been how the Internet access was to be provided. Further marks would have been scored for showing a router, a modem and/or a firewall connected to the Internet.

Candidates needed to improve on their description of an intranet. Candidate answers often described a local area network. Key points expected were that this is a private network with content only available to employees, that the content is provided from a web server and viewed with web browser software, and that the system is using Internet protocols (such as TCP/IP).

Answers for part **(b)(ii)**, the benefits an intranet would bring, needed improvement as they often lacked detail, for example, *'it will be fast as there are a limited number of users'*.

Detail about encryption has only recently been examined. Candidate responses were good. Candidates needed to improve on their answers for part **(c)(i)** as they tended only to explain why symmetric encryption was different to asymmetric encryption. Answers needed to state the mechanics of the process and use the computer terminology; that is the process first changes the plain text into cypher text using an algorithm and a key. It is then the same algorithm and key which is later used by the recipient to decrypt the cypher text.

Many candidates answered the final part **(c)(ii)** correctly.

COMPUTING

Paper 9691/04

Project

General comments

This report provides general feedback on the overall quality of project work for GCE Advanced Level Computing candidates. In addition, all Centres receive specific feedback from their Moderator in the form of a short report that is returned after moderation. This reporting provides an ongoing dialogue with Centres giving valuable pointers to the perceived strengths and weaknesses of the projects moderated.

The projects submitted covered a wide variety of topics with better candidates showing evidence of researching a problem beyond their School or college life.

In order to have the full range of marks available to the candidate, the computing project must involve a third party client whose requirements are considered and clearly documented at all stages of the system development. Centres are reminded that the project work is designed to test the candidates' understanding of the systems life cycle. The requirements are clearly set out in ***section 4*** of the syllabus. 'The Guidance on Marking the Computing Project' ***section 7.2*** acts as a useful checklist, for teachers and candidates, setting out the expected contents of each section.

Centres are also reminded that candidates should use this guidance for the expected contents of their reports rather than some of the A Level textbooks available for project work, which do not cover the full requirements of the Cambridge International Examinations syllabus. Candidates who prepare their work only using these text books and not the syllabus for guidance often miss out vital sections of their reports; or complete unnecessary work, for example, feasibility studies and cost benefit analysis.

Project Reports and Presentation

As usual, the presentation of most of the reports was to a very high standard, with reports word-processed and properly bound. Candidates should ensure that only material essential to the report is included so that they only submit one volume of work. Candidates are reminded that only authentic letters from clients and/or users must be used to provide evidence for the Evaluation, Implementation, Investigation and Analysis sections. These letters could be scanned in to the project report but must not be re-typed/typed out by the candidates.

It is strongly recommended that the structure of the candidate's report follows that of the mark scheme set out in the current syllabus. Essential evidence should not be relegated to appendices. This allows both teachers at the Centres and Moderators to easily check that work for all sections has been included. Also it is essential that the pages of the report are clearly numbered by the candidate.

Project assessment and marking

Nearly all Centres used the marking grid on pages 45-48 of the current syllabus to provide a breakdown of marks showing the marks given for each sub-section of the report. In order to aid the process of moderation, the completed grid should include references to the appropriate pages in the candidates' reports where evidence for each section can be found. Teachers should comment as to why they awarded the marks for each section. Moderators have noticed that where there is a good commentary provided by a teacher the marking is usually very close to the agreed standard.

Section 3

Comments on Individual Sections

The comments set out below identify areas where candidates' work is to be praised or areas of concern and are not a guide to the required contents of each section.

(a) Quality of report.

Most candidates set out their reports in the appropriate sections and made good use of illustrations including diagrams and screenshots. Weaker candidates sometimes did not include page numbers in their reports, this meant that teachers could not clearly identify to the Moderator where evidence was to be found and those candidates were unable to cross reference items within their report.

(b) Definition Investigation and Analysis

(i) Definition - nature of the problem

This is a brief introduction for anyone who is unfamiliar with the organisation and the area under investigation. Most candidates described the organisation and many identified the methods used; better candidates described the methods used, the origin of the data and indicated the form of this data.

(ii) Investigation and Analysis

In order to gain good marks candidates must clearly document client and user involvement in their investigation. Candidates need to consider carefully the evidence obtained from interviews, observation of the existing system and study of documents currently in use; then ask follow up questions to fill in any gaps in the knowledge obtained about the current system or requirements needed for the new system. Alternative approaches need to be discussed in depth as they would be applied to the candidate's proposed system.

The detailed requirements specification produced must be based on the information collected and include what the client needs the system to produce.

(c) Design

(i) Nature of the solution

The requirements specification set out in the analysis needs to be discussed with the client and a set of measurable objectives agreed. These objectives will then form the basis for the project evaluation.

Most candidates provided designs that included proposed data structures, layouts for input screens and reports required, better candidates used pseudocode and/or flowcharts to provide a detailed description of the processes to be implemented.

In order to obtain marks in the top two bands for this sub-section, candidates need to obtain evidence that their client has seen and commented on the design work, and then show what has changed as a result of these comments. Evidence from the solution is not required here.

(ii) Intended benefits

In order to obtain good marks for this sub-section, candidates should describe the benefits of their intended system, not just provide a list of general statements that could apply to any system.

(iii) Limits of the scope of solution

Candidates should describe the limitations of their intended system including an estimate of the size of any files required, not just provide a list of general statements that could apply to any system. File sizing estimates should be based on information provided by the client.

Full marks for the design section cannot be awarded without candidates clearly supplying evidence for **(i)**, **(ii)** and **(iii)**.

(a) Software Development, Programming Testing and Installation

(i) Development

Evidence of development should include program listings of code written by the candidate, data structures used and evidence of tailoring of software packages. For top marks the solution should have no logical flaws, match the design specification in **(c)(i)** and be annotated by the candidate.

(ii) Programming

It is important that the programming code in this sub-section is written by the candidate and not produced as a result of tailoring a software package. Marks should only be awarded to code that has been written by the candidate.

Candidates need to show that they can apply the programming skills developed at AS level in Paper 2 to a real situation. This includes technical programming competence and ensuring that their program could be maintained by writing self-documented code.

(iii) Testing

Evidence of testing needs to be supported by a well-designed test plan that includes the identification of appropriate test data, including valid, invalid and extreme cases, together with expected results for all tests. For top marks to be awarded the test plan should clearly identify that all parts of the system have been tested. Many candidates only tested the validation and navigation aspects of their system, and omitted to test that their system did what it is supposed to do, for example production of reports. This omission meant candidates were unable to gain marks in the highest band for this sub-section.

(iv) Installation

Most candidates provided an implementation plan containing details of user testing, user training and system changeover.

For good marks to be awarded written evidence from the client and/or user(s) must be included in order to show that the system has been seen, used and tested, and the candidate's plans have been agreed.

Centres are reminded that appropriateness of structure and exploitation of available facilities are not required for this sub-section of the report.

(e) Documentation

(i) Systems Maintenance Documentation

This sub-section of the report is a Systems Maintenance document. Many candidates incorrectly included Technical Documentation. Please see the current syllabus for details of what should be included in this sub-section.

For top marks to be awarded the candidate must explain how adaptive maintenance could be undertaken for their system.

(ii) User Guide

This section was completed to a good standard by most candidates. Centres are reminded that for full marks the candidate must include an index and a glossary for the terms used in their User Guide. This needs to be complete including details of how to install the new system, backup routines and a guide to common errors. Also good on-screen help should exist where this is a sensible option.

(f) Evaluation

Centres are reminded that in order to gain high marks candidates need to provide a detailed evaluation that includes the content set out in the guidance for marking projects section of the syllabus. Many candidates provided scant evidence for this section, if this is the case then there are few marks that can be awarded.

(i) Discussion of the degree of success in meeting the original objectives

Candidates need to consider each objective set out in **(c)(i)** and explain how their project work met the objective or explain why the objective was not met.

Candidates should also indicate where the evidence, probably from testing or feedback from the users of the system, could be found in their report to support these conclusions.

(ii) Evaluate the client's and users' response to the system

A response must be provided directly from the client and user(s) showing that they have used the system, not just reported by the candidate. The candidate should then evaluate their client's and users' responses.

For evidence in this section to be creditworthy, the candidate must include original letters, preferably on headed notepaper, signed by the client and not typed and/or composed by the candidate.

Centres are reminded that possible extensions and the good and bad points of their final system are not required for this sub-section of the report.