[C017/SQP009]

Higher Computing

Time: 2½ hours

NATIONAL QUALIFICATIONS

Specimen Question Paper

Attempt **all** questions in Section I.

Attempt **four** questions in Section II

Question 1 and Question 2
and **either** Question 3 **or** Question 4
and **either** Question 5 **or** Question 6

Attempt **one** Sub-Section of Section III. In this Section there are four Sub-Sections, one for each of the Optional Units

Computer Programming — *Page seven*
Artificial Intelligence — *Page ten*
Computer Networking — *Page thirteen*
Multimedia Technology — *Page fifteen*

For the Optional Unit chosen, attempt

Question 1 and Question 2
and **either** Question 3 **or** Question 4.

Note: for Multimedia Technology, attempt Questions 1 to 5 and **either** Question 6 **or** Question 7.

Read all questions carefully.

Write your answers in the two answer books provided. One answer book should be used for Sections I and II and the second answer book **must** be used for Section III.

Do not write on the question paper.

Write as neatly as possible.

SECTION I

Attempt all questions in this section

Marks

1. Name a software development environment with which you are familiar. Give an example of a *complex condition* in your software development environment. 2

2. State three characteristics you would expect to find in a well designed HCI. 3

3. Design notation is an essential tool within a design methodology that is used to represent software design. Describe, by means of an example, two design notations with which you are familiar. 4

4. The software development process is described as being *iterative*. State what is meant by this term. 1

5. A program is to be written that will read in a list of student marks, check that each mark is within an acceptable range, and determine the highest mark.

   Which two of the following algorithms will be used in this program?

   Counting occurrences
   Minimum
   Linear search
   Input validation
   Maximum 2

6. Describe a situation where an error would be generated from the operating system during the run-time of a program. 1

7. At the end of a sponsored walk, all the contestant data is entered into a file. Which algorithm from the list below will be required to evaluate the slowest time taken to complete the walk?

   Counting occurrences
   Minimum
   Linear search
   Input validation
   Maximum

   Give a reason for your answer. 2

8. (*a*) One method of representing a negative integer in a computer is by using the two's complement of the corresponding positive integer.

   Which of the following is the 8 bit two's complement representation of –7?

   (i) 00000111

   (ii) 10000111

   (iii) 11111001 1

   (*b*) Describe one way of storing a real number in computer memory. 1

Marks

9. A small business buys a desktop computer system with a multi-scanning monitor and a scanner.

   (*a*) What main feature distinguishes a multi-scanning monitor from a single frequency monitor? 1

   (*b*) The scanner is used to scan a 5 in by 7 in photograph at 600 dpi in 256 colours.

   (i) How much memory would be required to store the scanned image?

   (ii) Name two storage devices which could be used to store the image. 3

   (*c*) The desktop computer has an operating system which uses a GUI.

   Describe three functions of this type of interface. 3

   (*d*) The desktop computer is to be connected to a network.

   (i) What hardware needs to be installed in the computer?

   (ii) Describe one network topology which might be used in an office. 2

10. (*a*) Give one example of a communications protocol. 1

    (*b*) Why are protocols necessary in computer communications? 1

11. Programming languages may be classified by the type of problem which they are designed to solve.

    (*a*) Name two programming languages which are designed to solve different types of problem. For each language, state the type of problem it is designed to solve. 1

    (*b*) Give an example of the use of a scripting language in a GPP. 1

(30)

[*END OF SECTION I*]

SECTION II

Attempt FOUR questions in this Section

Question 1 and Question 2
and either Question 3 or Question 4
and either Question 5 or Question 6

Marks

1. A microcomputer has a 300 MHz processor, 64 MBytes of RAM, serial, parallel and USB interfaces and a 6 GByte hard disk. It is used to create on-line tutorials for software packages.

   (*a*) State two reasons why a computer needs interfaces to connect peripheral devices to the processor. 2

   (*b*) Clock speed is not the only way to express the throughput of this computer.

   Explain how each of the following can affect the throughput of this computer:

   (i) amount of memory installed;

   (ii) choice of hard disk drive. 3

   (*c*) A printer has to be added to the system. State two characteristics of a printer which you would consider when making a purchase. Explain why your chosen characteristics are important. 2

   (*d*) The computer system is to be used to create on-line tutorials for software packages.

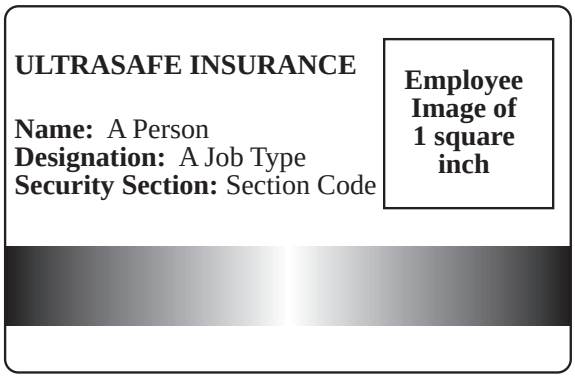
   (i) Suggest two types of software which might be used for creating on-line tutorials.

   (ii) State the purpose of your chosen software. 3

2. A security system is to be developed for a local insurance company. Each employee will be issued with a security card upon which will be encoded their personal details and a four digit Personal Identification Number (PIN). A photograph of the employee will also be displayed on each card.

   When keyed in, the PIN will be used by the system to check access rights to particular sections of the insurance building.

   The design of the security card is illustrated below.



   (*a*) List, in correct order, the stages involved in the development of software for this security system. 2

   (*b*) Identify two distinct objects and their corresponding operations that will be needed to produce the security cards. 2

   (*c*) It is particularly important that the security system is reliable. State what is meant by the term *reliable*. 1

   (*d*) At the design stage, it is decided that a database will hold all employee information. The company currently employs 650 people.

   (i) Suggest a suitable input device that could be used to digitise the employee photograph.

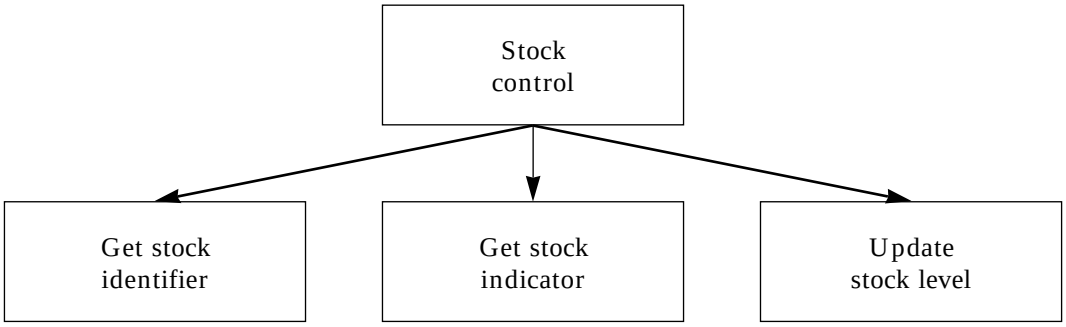
   (ii) The selected digitiser produces an image of 300 dpi resolution and 256 levels of grey scale. Calculate the amount of storage required to hold the employee photograph. State clearly any assumptions that you make. 3

   (*e*) Suggest two further measures that could be taken to increase security and, for each measure, identify any additional hardware or software requirements. 2

Attempt either Question 3 or Question 4

Marks

3. The structured chart below represents a section of a stock control system. The stock control system operates by increasing or decreasing stock levels according to information held in a stock transaction file. The stock transaction file contains a unique identifier for each stock item and an indicator of whether the stock should be increased or decreased in level.



(*a*) A module is written for each of the processes labelled in the above structured diagram. Each module will make use of parameter passing. Explain how the use of parameter passing can improve the portability of the software. 2

(*b*) For each of the modules, Get stock identifier, Get stock indicator and Update stock level, identify the type(s) of parameter that would be needed. 4

(*c*) When testing software it is desirable to use systematic testing. Describe the steps that you would take to systematically test the stock control program above. 2

(*d*) A 16 bit computer is used to develop this program. The stock code is represented as an integer in the high level language used. What is the maximum stock code value that can be represented in this system? State any assumptions that you make. 2

4. At Strictview Academy, students are awarded an overall course pass or fail. They need to achieve at least fifty percent (50%) in all examinations to get a course pass. This is illustrated in the table below.

Name	Mark 1	Mark 2	Mark 3	Result
Jane	32	52	60	Fail
James	45	67	83	Fail
John	52	63	65	Pass
			Total Passes	1

The Head of Department asks you to develop a computerised solution to this problem.

(*a*) Identify two distinct objects and their corresponding operations required to solve the problem above. 2

(*b*) Name a software development environment with which you are familiar. Describe how the complex condition required to determine a course pass would be written in the software development environment you have named. 2

(*c*) The solution to this problem could be developed in a High Level Language. Alternatively a higher level language such as a Fourth Generation Language or a General Purpose Package could be used.

Compare and contrast the use of a High Level Language and a higher level language to solve the problem at Strictview Academy. Your answer should refer to:

- customisation of the user interface;
- input validation. 4

(*d*) Outline a counting occurrences algorithm that would determine the Total Passes in the table above. You may write the algorithm in textual or graphical form. 2

Attempt either Question 5 or Question 6

Marks

5. (*a*) List four functions of a single user operating system. 2

(*b*) Most modern microcomputers have an operating system which supports multitasking.

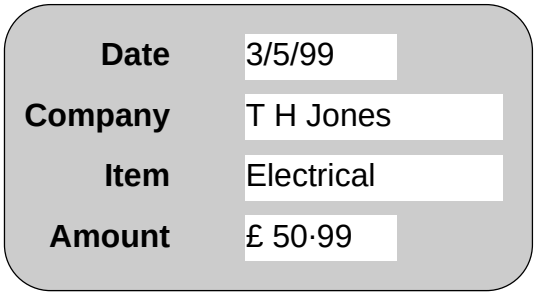
(i) Explain why multitasking is required in modern microcomputers.

(ii) What additional functions must an operating system have in order to support multitasking? 4

(*c*) Describe in detail the processes carried out by a network operating system when a user logs on at a microcomputer on a local area network. 4

6. A computer system has been created which allows the user to keep a record of bills which have been paid to various companies. Details of each bill are entered using the following input screen organisation.

Screen 1



A list of all payments to the same company are then displayed as follows.

Screen 2

Date	Company	Item	Amount
5/6/99	British Telecom	Phone Bill	£ 108·00
3/3/99	British Telecom	Phone Bill	£ 110·00
20/2/99	British Telecom	Install extra line	£ 45·00
		Total	£ 263·00

(*a*) Database software has been used to implement this system. Describe two features of database software which have been illustrated in the above diagram. 2

(*b*) It was intended that the list in screen 2 should have been arranged in order of date. This has not happened even though the computer operator sorted on the date field.

Explain why the list might not have been sorted as required. 2

(*c*) The users of the system would like it to be expanded to include more facilities. It has been suggested that a High Level Language be used to create a new program which would satisfy all the users' needs.

Give one advantage and one disadvantage of using a High Level Language to develop a solution to this problem. 2

(*d*) (i) At what stage in the software development process would the developers decide on whether to use a High Level Language?

(ii) What information would a developer need to help make this decision? 2

(*e*) After the new system is developed, information from old files will need to be transferred to the new system. Describe how the use of standard data formats would help in this process. 2

[*END OF SECTION II*]

SECTION III

Attempt ONE of the Optional Units in this Section

SECTION III—Computer Programming

Attempt Question 1 and Question 2
and either Question 3 or Question 4

Marks

1. Software development environments offer a range of tools to support the programmer.

   (*a*) A text editor, rather than a word processor, is used to alter program code. Describe two features of a dedicated text editor *not found in a word processor* that would support the editing of a program. 2

   (*b*) Give an example of a language in each of the following classes:

   (i) imperative language;

   (ii) declarative language;

   (iii) a language embedded in an application package;

   (iv) object-oriented language. 2

   (*c*) Describe how the following are used to detect errors in program code:

   (i) a trace debugging tool;

   (ii) breakpoints. 4

   (*d*) Compare the use of paper based debugging tools, such as a trace table, with on-line tools such as a trace facility. 2

2. Data structures allow problems to be modelled so that data processing can be carried out efficiently.

   (*a*) Describe the data structures *queue* and *stack*. 2

   (*b*) The stack data structure is associated with two main operations, pop and push. Describe in pseudocode or in another suitable form, the pop operation. 3

   (*c*) Describe one situation where a queue data structure could be used, and one situation where a stack data structure could be used. 2

   (*d*) Sequential files can be stored on magnetic disc or magnetic tape. These files can then be searched for particular values.

   Explain how you would choose between a linear search or a binary search if you were required to search for an item in a sequential file. 3

Attempt either Question 3 or Question 4

Marks

3. HStill Academy has 2050 pupils. All pupil data is held centrally and can be accessed for a variety of purposes. Here is an example of a pupil record in record card format.

Forename	Fred
Surname	Smith
Date of Birth	10.2.84
Class	3A3
Course	English, Maths, French, Computing, Latin

(*a*) (i) State two methods of representing the date of birth information in a program.

(ii) Explain which of these methods would be more efficient of processor time if two records were being compared. 4

(*b*) The records must frequently be searched on the Surname field. The entire set of pupil data is held in main memory for this operation. The binary search algorithm is used for the search operation.

(i) What conditions must be satisfied by the data if a binary search algorithm is used for the search operation?

(ii) Outline in pseudocode (or in some suitable form) the structure of the binary search algorithm in this case. 4

(*c*) Name two sort algorithms which could be used to sort this data while it is held in a main memory. Compare these algorithms in terms of their efficiency in the use of memory and of processor time. 2

4. A college requires a program to process test results for classes of students. Classes consist of up to 40 students.

   Here is a sample of the input data. Data will be input from the keyboard.

Student Code	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
1004	23	19	–1	79	–1	6	47	–1
1234	0	90	89	78	54	67	–1	23
1579	50	50	51	80	91	50	52	29
1921	87	100	89	76	93	67	56	50

   Results for each test are in the range 0–100, representing the scores achieved. A result of –1 indicates that the student did not sit a test.

   The final grade is decided in the following way.

   If the student has sat at least 6 tests, the final result is the average of the tests sat with grades being awarded according to the following table:

Result	*Grade*
0–39	*6*
40–49	*5*
50–59	*4*
60–69	*3*
70–79	*2*
80–100	*1*

   If the student has sat less than 6 tests, Result is set to –1 and a final grade of 7 is awarded.

   It is required to produce three files. A Raw Data file which contains a copy of the input data, a Results file which contains the students' numbers and grades, and a Text file which contains lines of the following format:

   Student 1004 has achieved a grade 7
   Student 1234 has achieved a grade 4.

   Several data structures are required to solve this problem along with file handling.

   (*a*) Describe how

   (i) a two dimensional array and

   (ii) an array of records

   could be used to store this information in main memory. You may illustrate your answer with a variable or type declaration in a language with which you are familiar. 2

   (*b*) Which representation would allow the programmer to produce more readable code? Explain your answer. 1

   (*c*) Describe how the calculation of a student's grade would be carried out for one of the two representations mentioned in part (*a*). You may use pseudocode or program code if you wish. 4

   (*d*) State which of these representations will allow the writing of the Raw Data file to be carried out with greater efficiency in terms of processor time. Explain your answer. 3

SECTION III—Artificial Intelligence

Attempt Question 1 and Question 2
and either Question 3 or Question 4

Marks

1. (*a*) Three main components of an expert system are the knowledge base, the inference engine and the explanatory interface. Describe the function of each component. 3

(*b*) An expert system is being developed to help members of expeditions in remote tropical regions to diagnose and treat medical conditions. The expert system is to be built using rules such as:

IF temperature > 36
AND skin colour is orange
AND symptoms include weakness
THEN problem might be Orange Marsh fever

(i) In this rule, the words "might be" indicate that there is some doubt about the diagnosis. How could the rule be adapted to deal with this? 1

(ii) Rules are not the only way to represent knowledge in an expert system. Describe one other way of representing the knowledge contained in the above rule. 2

(iii) Once the knowledge engineer has implemented the expert system, what further stages in the development process would be required before the software could be released commercially? 2

(iv) Advice rules suggesting appropriate treatment will also be added to the expert system. Write advice rules to represent the following information.

"*The best treatment for Orange Marsh fever is 25 mg of orthomyolite 3 times daily, or 15 mg if the patient is under 16 or over 70.*" 2

2. (*a*) A programmer is developing software to solve a problem in Artificial Intelligence. She could choose to use a declarative language (like Prolog) or an algorithmic language (like Pascal).

   (i) How is knowledge represented in a declarative language?

   (ii) Why is a declarative language particularly appropriate for solving AI problems? 3

   (*b*) The following is part of a knowledge base about Europe.

```
 1  is_in (paris france)
 2  is_in (berlin germany)
 3  is_in (vienna austria)
 4  is_in (london england)
 5  is_in (edinburgh scotland)
 6  is_in (scotland uk)
 7  is_in (england uk)

 8  currency (france franc)
 9  currency (germany mark)
10  currency (austria schilling)
11  currency (uk pound)

12  can_use (Y X) if currency (X Z)
13  can_use (Y X) if is_in (X Z)
    and can_use (Y Z)
```

   At the moment, the program will not fully answer the query

```
is_in (X uk)
```

   as a human might expect.

   (i) Explain why the program will not answer this query correctly.

   (ii) Write down one rule which could be added to the program which would enable the program to find all solutions to the above query. 2

   (*c*) Assuming that a depth first search is used, explain how the program would find the solution to the query 3

```
can_use (pound scotland)
```

   (*d*) Explain why the program cannot find solutions to the query

```
NOT (can_use (pound X))
```

2

Attempt either Question 3 or Question 4

Marks

3. The ability to understand "natural language" is one aspect of human intelligence which Artificial Intelligence (AI) researchers have attempted to model.

   (*a*) State two other aspects of human intelligence which Artificial Intelligence (AI) research has attempted to model. 1

   (*b*) Describe the difference between natural language processing and voice recognition. 2

   (*c*) Describe a practical application of natural language processing. 2

   (*d*) Describe two difficulties which are encountered when attempting to implement natural language processing. 2

   (*e*) Hardware developments have allowed some areas of AI research to become more successful over the last 10 years. Describe one such hardware development, and explain how it has contributed to the success of a particular area of AI research. 3

4. Pattern recognition is an important area of development in Artificial Intelligence.

   (*a*) State one application area where pattern recognition of visual input is used. 1

   (*b*) State one application area where pattern recognition of sound input is used. 1

   (*c*) Describe how system hardware constraints can limit the effectiveness of computer based pattern recognition. 2

   (*d*) Describe how the input data can affect the effectiveness of computer based pattern recognition. 2

   (*e*) A pattern recognition application will probably use some brute force search method to search its database. Describe briefly one brute force search method, and explain how heuristics could be used to improve the efficiency of the search. 4

SECTION III—Computer Networking

Attempt Question 1 and Question 2
and either Question 3 or Question 4

Marks

1. Doctors in a health centre are considering installation of a local area network. There will be a terminal in each of the six doctors' rooms and one computer in the administrator's office. Each terminal will have access to the local hospital's database and its on-line medical information system. The network must allow for future expansion.

   (*a*) A bus topology and a star topology are being considered.

   For each topology, state one advantage and one disadvantage in this situation. 2

   (*b*) The doctors often require access to worldwide on-line information systems.

   (i) Explain why a gateway may be required to enable this access.

   (ii) Give two reasons why medical personnel might consider it worthwhile to subscribe to such on-line systems. 3

   (*c*) The doctors hope to make use of video conferencing facilities once the network is established.

   Describe the term *video conferencing*. Your description should include details about the transmission media and multimedia hardware required. 3

   (*d*) Explain why video conferencing gives better results when used with a point to point direct connection rather than by using the Internet. 2

2. (*a*) State the meaning of the term "internetwork". 1

   (*b*) Name a piece of equipment which is required in an "internetwork" but not in a network. 1

   (*c*) International data transmission standards are necessary when designing communication systems.

   (i) Explain why there is a need for international data transmission standards. 2

   (ii) Describe two benefits which might arise from not adopting international standards. 2

   (*d*) The OSI model is a standard for computer to computer dialogue which divides the communications process into seven layers. Describe the functions carried out by:

   (i) the transport layer;

   (ii) the network layer. 4

Attempt either Question 3 or Question 4

Marks

3. Some companies set up intranets, rather than allowing workers direct access to the Internet.

   (*a*) State one advantage and one disadvantage for the company of using an intranet rather than the Internet. 2

   (*b*) What is the purpose of a network operating system? 1

   (*c*) Describe the following terms in the context of an intranet:

   (i) peer to peer network;

   (ii) client server relationship;

   (iii) distributed processing. 3

   (*d*) "Communications systems are impersonal and mean that less human contact is experienced."

   Discuss this view giving two points for and two points against. 4

4. (*a*) Describe how a firewall is used to provide security for a school network which is directly connected to the Internet. 3

   (*b*) Explain what is meant by the URL

   `ftp://ftp.somesite.sch.uk/names.doc` 3

   (*c*) Describe in technical detail how a file is transferred between two computers on a network using the TCP/IP protocol. 4

SECTION III—Multimedia Technology

Attempt all Questions on this page
and either Question 6 or Question 7

Marks

1. Describe how data is stored and organised on a CD-ROM. You should mention how the system is designed to cope with small defects in the fragile medium. 4

2. When you attempt to scan a black and white clip art item using a flatbed scanner at 2400×2400 dpi resolution, the resulting image is almost entirely white. There is no fault in the hardware.

   (*a*) State two reasons why the image has not been captured as you might have hoped, and describe how you could use the scanner software to correct the problem. 4

   (*b*) Text capture using a scanner is one method of text input. There can be problems with this method, even when the text image is scanned correctly. Describe two problems which are associated with this method of text capture. 2

3. Name two facilities which you would expect to find in a professional Desktop Publishing package but not in a full-featured Word Processing package. 2

4. When elements of a multimedia presentation are printed to a laser printer for distribution to the audience, images must be transformed so that they can be printed using a black and white (not grey scale) output device.

   Outline how this process is carried out by the computer software. 3

5. An Educational software company wishes to produce a language learning package with the following facilities:

   - display of text in English and in the language being learned
   - display of still graphical images in multiple colours
   - short video and audio sequences to demonstrate the language being learned
   - the ability to have the user repeat spoken phrases and to have this compared with the original so that they can have feedback on their progress.

   Specify in technical detail a computer system which could readily support such an application. 5

Attempt either Question 6 or Question 7

Marks

6. JPEG and GIF are common file formats used for graphic images. Both use a form of data compression.

   (*a*) State the types of graphic image to which each format is best suited. 1

   (*b*) Outline the method of data compression used in either JPEG or GIF format files. 2

   Music is an important part of multimedia.

   (*c*) Describe how music data is represented:

   (i) in a MIDI file;

   (ii) in a file containing music captured using a sound input card and a microphone. 4

   (*d*) Outline how you would go about transferring music from an audio cassette tape recording to audio CD (on CD-R media) using multimedia hardware and software. You should give details of all data formats used. 3

7. A computer based learning package about driving a car will contain moving images. These could either be video or an animated sequence. The software used limits the size of the moving images to 5 cm square.

   (*a*) Describe the characteristics of each of these forms of moving image representation in terms of their storage requirements, data representation and data input methods. 5

   (*b*) What advantages could there be for the user of the training package if an animated sequence were used instead of video? 2

   (*c*) Computer training packages like this can be enhanced by creating 3 dimensional effects.

   Describe any one technique which can produce 3D effects on a computer system. 3

[*END OF QUESTION PAPER*]

[C017/SQP009]

Higher Computing

NATIONAL QUALIFICATIONS

Specimen Marking Instructions

SCOTTISH QUALIFICATIONS AUTHORITY

Higher Still Computing

Higher level

Marking Instructions

The outline marking instructions below indicates the level of response required of candidates to achieve the marks available. It is not a comprehensive list of all possible valid responses. In many cases alternate or additional valid responses will be possible. These would be accepted as long as they achieve the standard indicated below.

Candidates may choose to illustrate responses with examples from particular computer systems, languages or software packages with which they are familiar. While it is helpful if candidates identify these, appropriate exemplification will be accepted. In examples, minor syntax errors will be ignored, except where correctness is specifically required.

Section 1

1	Any valid complex condition Correct syntax for named software development environment	1 mark 1 mark	2 marks
2	Three stated from: consistent format; meaning full feedback; easy reversal eg undo;verification for destructive action; amount of info be memorised by user; good organisation of commands; help facilities; simple/meaningful commands; rapid assimilation; meaningful error messages; consistency of labels, abbreviation and codes; minimal input actions provision for multiple language levels.	1 mark for each of 3 points	3 marks
3	structured chart + example pseudocode + example data flow diagrams + example flowcharts + example	1 mark for each of 2 notations 1 mark for corresp. example	4 marks
4	Valid description such as revisiting a stage in the SDP to modify it in the light of experience gained at a later stage.	1 mark	1 mark
5	input validation maximum	1 mark for each	2 marks
6	run-time - divide by zero; I/O errors	1 mark	1 mark
7	Minimum comparing of times held in file to find min. value	1 mark for each	2 marks

8a	iii) 11111001	1 mark	1 mark
b	Real numbers are stored as mantissa and exponent	1 mark	1 mark
9a	A monitor that can operate at different refresh rates	1 mark	1 mark
b	5 x 7 x 600 x 600 x 1 byte (1 260 000 bytes) 2 of High density (1.44Mb) floppy disc, Zip disc, Hard disc drive *CD-ROM not allowed, but allow CD-R, CD-RW*	1 mark 2 x 1 mark	3 marks
c	designed for the user; consistent display ease of use for non-expert	1 mark 1 mark 1 mark	3 marks
d	hardware - network card topology - bus/star/ring with brief description	1 mark 1 mark	2 marks
10a	Any valid COMMUNICATIONS protocol, eg FTP, http, X25	1 mark	1 mark
b	without protocols data could not be comprehensibly received by computer system	1 mark	1 mark
11a	Any two valid pairs eg Prolog – AI Cobol – Commercial Pascal – Teaching programming	0.5 mark for each pair	1 mark
b	A brief description of such a use, eg Word Basic in MS Word	1 mark	1 mark

Section 2

1a	Any **two** of Compensate for different speeds Compensate for different data encoding Buffer data transfer Compensate for different signal characteristics	1 mark each for **two** points	2 marks
b	i) larger RAM allows more programs/data to be held in memory, reducing the need for slower access to disks. ii) affected by interface bus width, rotation speed, bus speed	1 mark 2 x 1 mark	3 marks
c	Any two valid characteristics, eg • Interface type (serial, parallel, USB, network) • print method (ink jet, laser, …) • print speed (ppm) Brief explanation of each	 2 x 0.5 mark 2 x 0.5 mark	2 marks
d	eg Scanner software – to capture images Authoring software – to construct presentation *Purpose stated must be valid in context*	2 x 0.5 for software 2 x1 mark for purpose	3 marks

2a	analysis design implementation testing evaluation documentation	1 mark for completeness 1 mark for correct order	2 marks
b	<u>object</u> <u>operation</u> employee digitise/adjust threshold/place etc.. image text position/resize/ etc.. PIN magnetically encode Accept any other valid object/operation	1 mark each of two object/ operation pairs	2 marks
c	Reliable is how well a program operates without stopping due to design faults.	1 mark	1 mark
d(i)	scanner or digital camera	1 mark	
d (ii)	300x300x1 inch=> 90,000 pixels 256 greys = 8 bit depth => 90,000 bytes	1 mark 1 mark	3 marks
e	voice print - microphone sound digitisation and recognition thumb print - scanner image digitisation and matching any other valid security mechanism with accompanying hardware requirements.	1 mark 1 mark or 1 mark 1 mark	2 marks

3 a	Parameter passing reduces a module's dependency on global variables Modules can therefore be reused without change	1 mark 1 mark	2 marks
b	Module Input Output 1 StockIdentifier: integer 2 StockIdentifier: integer StockIndicator:integer 3 StockIdentifier, StockIndicator: integer Stocklevel:integer *Accept expression as PROCEDURE headings etc*	 1 mark 1 mark 2 x 1 mark	4 marks
c	Bottom-up (test each module logic individually and integrate) Top-Down (test data flow and control with empty modules)	1 mark 1 mark	2 marks
d	It is likely that an **integer** will be represented in 16 bits. Integers are usually represented in two's complement notation. The largest value is 32767. *Accept also 65535 (if number assumed to be positive integer).*	1 mark for assumption 1 mark for value	2 marks

4a	Mark – integer value Insert/centre Result Calculate Total Passes Calculate	1 mark for each obj/op pair	2 marks
b	Eg Pascal If ((Mark[1,1]>50) and ((Mark[1,2]>50) and ((Mark[1,3]>50)) then eg Clarisworks Spreadsheet And ((B2>0.5); ((C2>0.5); ((D2>0.5)) *No marks simply for identification of a SDE.* *Accept any valid response, allow minor errors in syntax*	1 mark for comparisons 1 mark for AND	2 marks
c	eg Comparison based on HLL and GPP (Database) *Examples of valid points*. Programming in a HLL would allow complete flexibility using the entire resources of the Operating System (GUI etc), whereas use of a GPP would only allow access to a limited subrange of features. Graphical features might be available, but mouse-over context sensitive help might not, in a GPP. Input validation is possible in many GPPs, but tailored user feedback on errors would be easier to implement in a HLL On the other hand, learning time for a HLL is typically greater than in a GPP.	4 x 1 mark	4 marks

d	For each student result do
	if result = 'pass' then
	add 1 to count
		1 mark
		0.5 mark
		0.5 mark
			2 marks

5a	• manage User Interface • manage Filing system • manage memory allocation to applications/processes • manage peripheral I/O *Accept component functions of these eg maintain FAT or similar. Accept references to file locking, but NOT to aspects of multi-user file or memory management.*	0.5 marks per function	2 marks
b(i) (ii)	users expect to run multiple programs/GUIs require multitasking to detect events/ eg more sophisticated memory management, more sophisticated file handling		4 marks
c	User enters username and password Data is encrypted and sent to server Server validates against user database Message set from server to client machine to confirm or reject login.	4 x 1 mark	4 marks

6a	Two from Calculated fields ; reporting with subtotalling ; screen layout design	2 x 1 mark	2 marks
b	The field has been created as Text and not as a Date type this would result in a sort that is not in the expected order.	2 x 1 mark	2 marks
c	Advantage – total flexibility of data structures, user interface, etc Disadvantage – Higher cost of production due to longer development cycle	1 mark 1 mark	2 marks
d	(i) Implementation stage (ii) Need to know the programming expertise of the development team **OR** need to know whether data types and data structures can be supported in the *target* language	1 mark 1 mark	2 marks
e	Production systems use proprietary binary file format for efficiency. Utilities typically exist or can be written which can convert these into standard formats such as Comma Separated Values. Exporting from the GPP into eg CSV, and then translating the CSV into the new binary format will allow this transfer to take place	1 mark 1 mark	2 marks

Section 3 Computer Programming

1a	Automatic line numbering in languages which require it Highlighting of keywords / reserved words eg making them bold or differently coloured Automatic layout of program structures, such as indenting the contents of a procedure or an IF structure.	1 mark for each of two items	2 marks
b	imperative language - Pascal, Cobol, Fortran declarative language - Prolog a language embedded in an application package - Word basic object oriented language - C++, Small talk	0.5 mark 0.5 mark 0.5 mark 0.5 mark	2 marks
c	i) Trace debugging tool allows inspection of variables and logical execution of code on a line by line basis ii) Breakpoints – allow the program to be run normally, and to stop when the breakpoint is reached. Values of variables, stack etc are available for that point in the execution of the code.	2 x 1 mark 2 x 1 mark	4 marks
d	Trace facility on-line allows the tracking of values of variables, exits from procedures, transfer of control as the program is executed, giving information on screen as program is executed. Trace table - manual calculation of variable content at each stage of program execution. Relies on the programmer following the code exactly as a computer would do and calculating manually the variable values. Room for human error.	1 mark 1 mark	2 marks

2a	Queue - Description of first in-first out list Stack - description of last in-first out list May refer to specific implementation or to related operations	1 mark 1 mark	2 marks
b	(checking value at top of stack, stack assumed to build from 0 up) if top of stack pointer = 0 then stack empty else item to be popped = item pointed to by top of stack pointer reduce top of stack pointer by 1 end	 1 mark 1 mark 1 mark	3 marks
c	Queue - 'Job queue' *or* fill/empty a buffer *or* … Stack - store return address when a subroutine is called *or* …	1 mark 1 mark	2 marks
d	Linear search can be applied to any list structure Binary search requires items to be in order and addressable Binary search is more efficient, but could only be applied to a file if the criteria were satisfied.	1 mark 1 mark 1 mark	3 marks

3a	i)record structure with components for each item of date text (string) of ASCII characters integer – numerical offset from some reference date ii) eg record vs string : strings could not be compared for alphabetical order because of the structure required so would have to be converted to another form, whereas records could be compared by year then month then day.	2 x 1 mark 2 x 1 mark	4 marks
b	i) The records must be stored in alphabetical order of surname The list structure must be addressable (ie array rather than linked list) ii) ask for name to be searched for repeat {0.5 mks include until here} determine midpoint of list check value of midpoint for target name (target found) else test if whole list searched (search space exhausted) else test if midpoint value is less than target (still possible to find target) and set lower pointer to middle + 1 else set upper pointer to middle - 1 end of repeat when item found or end of list reached.	2 x 0.5 marks 0.5 mark 0.5 mark 0.5 mark 0.5 mark 0.5 mark 0.5 mark	4 marks
c	eg bubblesort, quicksort Bubblesort is economical of memory but may require much processor time Quicksort requires less processor time on average, but is very demanding of memory	1 mark 1 mark	2 marks

4a	eg Type Student List = ARRAY [1..40][1..9] of integer; Type Student Rec = RECORD Student ID : integer ; Test Results: ARRAY [1.8] of integer ; END; Student List = Array [1..40] of Student Rec ;	 1 mark 1 mark	 2 marks
b	Array of records, because it uses **sensible identifiers** to represent the different components of each record.	1 mark	1 mark

c	Set total mark to zero, set number of tests to zero
	
	For each of the test marks
	If the mark is valid
	Add mark to total mark
	Add 1 to number of tests
	End if
	End for
	Calculate average
	If number of tests is less than 6 then
	Set grade to 7
	Else
	Case average of
	0 - 39 Set grade to 6
	40 - 49 Set grade to 5
	50 - 59 Set grade to 4
	60 - 69 Set grade to 3
	70 - 79 Set grade to 2
	80 - 100 Set grade to 1
	end case
	end if
		0.5 mark
		
		0.5 mark
		
		1 mark
		
		0.5 mark
		
		0.5 mark
		
		1 mark
			
			4 marks

d	eg Writing the two dimensional array could require a nested FOR loop to write the individual integers, while Writing the records would require a simple loop So the Record representation would require less write-to-file operations and would be more efficient *But other valid arguments can be made depending on implementation language.*	 1 mark 1 mark 1 mark	 3 marks

Section 3 Artificial Intelligence

1a	Knowledge Base - The special knowledge stored here written in a knowledge representation language e.g rules or frames + database Inference Engine - reasoning part. The IE determined which question to ask the user in which order, then matches the users answers with the KB Explanatory Interface - (user interface) communicate with the user. Must ask the user appropriate questions in an easy manner and explain why question asked and how answer obtained.	1 mark 1 mark 1 mark	3 marks
b	i) using a certainty factor ii) To represent this knowledge as a fact has_condition(orange marsh fever, orange, weak, high temperature) iii) The software must be tested; The software must be evaluated iv) ADVISE 25mg orthomyolite three times daily IF patient_age >=16 AND patient_age<=70 AND disease is Orange Marsh Fever ADVISE 15mg orthomyolite three times daily IF patient_age <16 OR patient_age>70 AND disease is Orange Marsh Fever	1 mark 1 mark 1 mark 1 mark 1 mark 1 mark 1 mark	7 marks

2a	i) as a set of facts and rules ii) programs in declarative languages require a description of the problem rather than a method of solution, as in imperative languages. In AI, problems tend to suit being described rather than being solved by a predetermined list of instructions	1 mark 1 mark 1 mark	3 marks
b	• a human would expect the names edinburgh and london in the responses but the program as written will not return this • is_in (x z) if is_in (x y) and is_in(y z)	1 marks 1 mark	2 marks
c	Attemps to use rule 12, instantiating Y to pound and X to scotland, but fails as there is no corresponding currency() rule Attempts to use rule 13, so attempts to satisfy sub-goals •is_in() is satisfied by rule 6 •can_use – attempts rule 12 again. Subgoal currency() succeeds at rule 11 So the query succeeds	0.5 mark 0.5 mark 0.5 mark 0.5 mark 0.5 mark 0.5 mark	3 marks
d	Solution to rules 11 and 12 without NOT are x=UK, Edinburgh, Scotland, England, and these solutions would simply be negated by the NOT. If you wanted to establish which places you could not use the pound you would need a new rule.	1 mark 1 mark	2 marks

3a	Eg Visual identification of objects Deductive reasoning (eg diagnosis)	0.5 mark 0.5 mark	1 marks
b	Speech recognition involves translating spoken symbols (words) into corresponding written symbols while Natural language processing involves the semantic analysis of sequences of words	1 mark 1 mark	2 marks
c	eg automated translation between human languages Where rather than just translate word by word, the meaning of whole phrases and sentences is translate.	1 mark 1 mark	2 marks
d	Words with more than one meaning (record) Words which can be more than one part of speech (bearing)	1 mark 1 mark	2 marks
e	Parallel Processing Use of more than one processor to process task Each task divided into discrete subtasks Speeds up either computer vision or neural networks	1 mark 0.5 mark 0.5 mark 1 mark	3 marks

4a	person identification	1 mark	1 mark
b	speech recognition	1 mark	1 mark
c	Pattern recognition requires a large database of references to be searched quickly. Insufficient RAM will reduce the size of the database which can be searched Insufficient processor speed (or throughput0 will reduce the rate at which the database can be searched	 1 mark 1 mark	 2 marks
d	Input data can differ from what is stored in the database, eg an object may be viewed from a different angle. Depending on the programming of the pattern recognition system, the object may not be recognised.	1 mark 1 mark	2 marks
e	• A brute force method would carry out an exhaustive search • trying to match, pixel by pixel, the search item against every image in the database. • heuristics attempts to cut down the search by applying a rule of thumb • quickly reduce comparisons - in this example you might count the colour codes of the source and target quickly eliminate mismatches and avoid further in-depth image comparisons.	1 mark 1 mark 1 mark 1 mark	4 marks

Section 3 Computer Networking

1a	Bus: Advantages • easy to attach new nodes at any point of cable • cheaper than other options; • one node out of action doesn't affect the rest of the network Disadvantages • Common cable - if it breaks, channel failure, whole network doesn't work • single collision zone may reduce overall bandwidth Star: Advantages • all links connect directly to central node; • high overall bandwidth possible depending on central node type; Disadvantages • entire network is dependent on the central node working • if line goes down only one node affected, but if central node fails, whole network will fail • higher cabling costs	2 x 0.5 mark for one advantage and one disadvantage 2 x 0.5 mark for one advantage and one disadvantage	2 marks
b	i)Transfer of data between two (or more) networks involving change of protocols ii) up to date information on the most recent research communication with other practitioners to exchange ideas.	1 mark 2 x 1 mark	3 marks
c	video conferencing is the live connection of two or more people (at different sites) using computer networks to transmit audio and video data. Hardware - Each participant has a video camera, microphone and speakers mounted on their computer. As the two participants speak to one another, their voices are carried over the network and delivered to the other's speakers and whatever images appear in front of the camera appear in a window on the other participant's monitor. To overcome the bandwidth and latency limitations of current networks, video compression is often used. ISDN is a set of protocol and interface standards that effectively constitute an integrated (voice, video and data) telephone network. These standards promote global availability and compatibility of ISDN products and services. JPEG compression of still pictures; MPEG compression and storage of moving pictures.	1 mark for description/ definition 2 x 1 mark for two points of h/w and s/w	3 marks
d	point-to-point - data is transmitted directly to receiver. Little interference. Speed of data transfer since in real time. Require little delay internet - Transfer not direct so time delay. Speed/accuracy of data transfer slower/greater	1 mark 1 mark	2 marks

2a	A network of interconnected networks organised so that communication is possible.	1 mark	1 mark
b	Router (but allow gateway)	1 mark	1 mark
c	• standards allow signals to be interpreted in the same way at sender and receiver, allowing standard hardware to be used; • standards allow data/messages to be interpreted the same way at sender and receiver • Not using standards might give greater security as signals would not be recognised Not using standards allows the tailoring of transmission characteristics to one's own data transmission needs	1 mark 1 mark 1 mark 1 mark	4 marks
d	Transport layer provides two-way, reliable, cost effective, end to end exchange of data; may involve multiplexing and re-sizing of blocks. Flow control and sequencing of the data blocks is performed at this level. Network layer takes packet-sized data blocks from the transport level and maps the addresses to network addresses. If routing required, then responsibility for this is also taken here.	2 x 1 mark for two points for each layer	4 marks

3a	Advantages • reduced cost (no wide area communications costs, no modems required, no subscriptions necessary) • dedicated pages of information may be set up; • valuable time not wasted browsing unnecessarily • no external security threats Disadvantages • information may be too restricted • not as up to date as Internet • lack of communication in a global market Allow some latitude in expression. Other valid answers possible. Points must be non-trivial.	1 mark for any valid point 1 mark for any valid point	2 marks
b	Network operating system controls the processes of communication between the host computers, all of which may be very different from one another.	1 mark	1 mark
c	peer to peer network simple networking strategy, not involving a dedicated server where any station can make its resources available to the rest of the stations on the network. client/server stations do not have equal status - it is either a client or a server; the user (client) is allocated privileges which permit/deny access to certain resources. The server contains info of user IDs and privileges. distributed processing refers to a variety of systems that use more than one computer or processor to run an application. A LAN may be designed so that a single program can run simultaneously at various sites. Most distributed processing systems contain sophisticated software that detect idle CPUs on the network and parcels out programs to utilise them.	3 x 1 mark	3 marks
d	Response should be balanced	2 x 1 mark for points for 2 x 1 mark for points against	4 marks

4a	Expect answers in terms of packet filtering types of firewall, wide variety of responses possible. Typical units of response will include: • firewall computer will only transfer packets for particular ports • firewall computer may accept/reject packets from certain IP addresses • firewall rules may force client computers to route traffic via more secure "bastion hosts" Annotated diagrams are acceptable.	3 x 1 mark for valid units of response	3 marks
b	The URL describes The transfer protocol, in this case ftp The name of the remote host, in this case ftp.somesite.sch.uk The file or resource on the remote computer, in this case names.doc	3 x 1 mark	3 marks
c	It is not expected that the actual codes used by the ftp client and server programs would be used, but correct listing of these would be acceptable. • connection is established between the two computers • the transfer protocols, eg binary or text transfer, are established • the existence and permissions of the requested file are verified • the file is transferred in small chunks, each chunk is acknowledged (*) • completion of transfer is acknowledged and the connection is terminated *Note that processes such as reassembly of packets into correct order occur below the level of the ftp application and gain no marks in this question*	4 x 1 marks for four points – (*) must be one of the four	4 marks

Section 3 Multimedia Technology

1	Mention of: Pits and Lands Spiral arrangement with sectors in sequence (or single track…) Sectors of 2048 bytes Mapped by software to 512 byte sectors ECC code after each sector to help protect data against corruption	4 x 1 marks for each of 4 valid points	4 marks

2a	Contrast on original image is actually poor (eg pencil drawing) Threshold value set wrongly in scanning software	2 x 1 marks	4 marks
b	Similar looking characters confused Software attempts to interpret graphics as text Software fails to interpret text layout correctly (eg columns not recognised) *Allow* failure to recognise words in different language *(since some packages allow setting target language)*	2 x 1 marks	2 marks

3	Eg Kerning; control of positioning of images/text to very fine tolerances; Text wrap around graphics; Image cropping; colour separation of output.	2 x 1 mark	2 marks

4	The process seeks to avoid "blobs" of black and white corresponding to colours in images. Images are analysed for colour and intensity/texture. A range of half tone patterns is substituted for these colours/textures in the output image by the printing software	3 x 1 mark	3 marks

5	• Min 15" Video display, 640X480 pixels in 16 bit colour, with hardware acceleration • 200 mHz Pentium with hardware assisted MPEG1 capability • Minimum RAM 64MB to support speech recognition • Hard Disk space 1GB • Sound Card output quality, 44.1kHz, 16 bit sampling rate	1 mark 1 mark 1 mark 1 mark 1 mark	5 marks

6a	JPEG best for photographic type images GIF best for images with little colour gradient (eg cartoons)	2 x 0.5 marks	1 mark
b	Indication of compression algorithm Indication of how data to be compressed is selected	1 mark 1 mark	2 marks
c	Note that the question refers to storage of data in files MIDI – Sequence of Descriptions of each note, with values for each characteristic One value identifies separate channel for each instrument Information for generating sounds of different instruments held in separate library file Digitised sound – sequence of values (pairs of values if in stereo) Each value is a sample of the total sound for a small, constant interval of time Typically 16 bits per channel, with sample rates around 22 or 44 kHz	2 x 1 marks for 2 valid points 2 x 1 marks for 2 valid points	4 marks
d	• audio tape is input via sound card line input, • digitised to AIFF format file – each track is a separate file • CD-R software used to generate audio CD, one file per track with separators	3 x 1 mark	3 marks

7a	**video** storage requirements - 100 ppi, 40ppcm 5x5 = 25x1600 = 40000 pixels x 24 = 120kbytes per uncompressed frame data representation - MPEG 1 (i-frames, p-frames and b-frames) input methods - digital camcorder delivers MPEG bitstream (e.g. Firewire) OR camcorder + video card + MPEG encoder (might be on card) **animated sequence** storage requirements - see above data representation - Quicktime, input methods - via some art package, and assembled in eg Macromedia Director	3 x 1 mark 2 x 1 mark	5 marks
b	animation which consists of large areas of flat colour, but uses relatively small numbers of colours could be designed much more clearly than live video which could be visually noisy and messy (compression artefacts). This would make it easier for the user to assimilate information. Small videos on a low-resolution monitor do not look very good.	1 mark 1 mark	2 marks
c	• 3D modeller • 3D renderer to generate image frames (GIF, TIFF) • Put into Director as cast members to generate image sequence (quicktime). Select MPEG for 3D-image output from Director.	1 mark 1 mark 1 mark	3 marks

[END OF MARKING INSTRUCTIONS]