Barker College

2001
Year 12 Trial HSC
EXAMINATION

SOFTWARE DESIGN and DEVELOPMENT

General Instructions

- Reading time - 5 minutes
- Working time - 3 hours
- Write using blue or black pen
- Flowchart templates may be used
- Write your **Student Number** and your **teacher's initials** on each sheet of writing paper used.
- Start a new sheet of paper for each question

(Section I) **Multiple Choice**. Pages 1 – 5

Total marks **(20)**
- Attempt Questions 1 - 20
- Allow about 35 minutes for this section

(Section II) **Core**. Pages 6 – 9

Total marks **(60)**
- Attempt Questions 21 - 23
- Allow about 110 minutes for this section

(Section III) **Option Topic**. Pages 10 – 11

Total marks **(20)**
- Attempt Question 24
- Allow about 35 minutes for this section

CALCULATORS ARE NOT PERMITTED

Section I

Total marks (20)
Attempt Questions 1 – 20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet.
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample   2 + 4 = (A) 2   (B) 6   (C) 8   (D) 9

A ○   B ●   C ○   D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ●   B ✖   C ○   D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows:

correct

A ✖   B ✖   C ○   D ○

1   A method of representing integers within a computer that has two possible representations of 0 and has the left most bit as a '1' to indicate the number is negative is called

   (A)   long integer
   (B)   2's compliment
   (C)   sign and modulus
   (D)   floating point

2   The correct order for the steps in the translation of high level language to machine code is

   (A)   Syntactic Analysis, Code Generation, Lexical Analysis, Code Optimisation
   (B)   Code Generation, Lexical Analysis, Syntactic Analysis, Code Optimisation
   (C)   Syntactic Analysis, Lexical Analysis, Code Generation, Code Optimisation
   (D)   Lexical Analysis, Syntactic Analysis, Code Generation, Code Optimisation

3   A programming language that uses inference rules and assertions can best be described as

   (A)   a machine language.
   (B)   a procedural language.
   (C)   an event driven language.
   (D)   a declarative language.

4   The error message "Incompatible assignment to variable" occurs when

   (A)   an integer is assigned to a real number variable.
   (B)   a real number is assigned to an integer variable.
   (C)   a character is assigned to a string variable.
   (D)   the program attempts to write past the end of an array.

5   The syntax for a LOONA is given in BNF:

   LOONA ::= 'a' | 'b' <HAP><HAP>
   HAP ::= 'A' | 'B'

Which of the following is a legitimate LOONA?

   (A)   abAB
   (B)   AAA
   (C)   aB
   (D)   bAB

6   The following are descriptions of four methods of language translation.
   (i)   The process of converting an entire source program written in a high-level language into machine language before executing any of the program.
   (ii)   A translator program that translates one line at a time of the high-level source code into a low-level object code, whereupon the computer executes that line before the next line is translated.
   (iii) A section of high-level language code which is frequently used in the program is translated as one unit, while the rest of the code is translated one line at a time.
   (iv)   A process by which individual modules of a large program are translated without the need to translate the entire program. All necessary translated units are later collected together by the linker before execution.

Which row in the table below correctly matches all descriptions to their translation method?

	Interpretation	Independent Compilation	Incremental Compilation	Compilation
(A)	(ii)	(iii)	(iv)	(i)
(B)	(iii)	(iv)	(ii)	(i)
(C)	(i)	(iii)	(iv)	(ii)
(D)	(ii)	(iv)	(iii)	(i)

7 Which type of loop terminates when the condition being tested is true?

(A) REPEAT......UNTIL
(B) WHILE.......ENDWHILE
(C) CASEWHERE........ENDCASE
(D) IF........ENDIF

8 An array is represented by the diagram below.

7	2	3	1	8	6	9	4	7	1

An ascending order bubble sort is performed on the contents of the array. After two passes through the array it would appear as:

(A)
2	3	1	4	1	6	7	7	8	9

(B)
2	3	1	7	6	8	4	1	7	9

(C)
1	1	2	3	7	8	6	9	4	7

(D)
2	1	3	6	7	4	7	1	8	9

9 Which of the following would **not** enhance the user friendliness of a computer program?

(A) Context sensitive help
(B) User manual
(C) Installation manual
(D) Intrinsic documentation

10 A stub is

(A) a procedure which validates data.
(B) used to locate a syntax error, report it and stop execution.
(C) a substitute for a real subprogram.
(D) a stop within the program which occurs if a certain event happens.

11 Below is a sample Pascal program:

```
program GoodOne;
(i)    {This program reads in a students name and ID number and}
       {prints them in a specified format   }
var
(ii)   Counter: integer;
       StudentName: string;
       IDnumber: integer;
begin
       showtext;
(iii)  writeln('Please enter student name');
       readln(StudentName);
       writeln('Please enter student ID');
       readln(IDnumber);
       writeln(StudentName : 10, IDnumber : 10);
end.
```

The areas labelled (i), (ii) and (iii) demonstrate

(A) comment in code, a constant and an output debugging statement.
(B) comment in code, intrinsic documentation and an output statement.
(C) internal documentation, a variable and a stub.
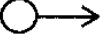(D) internal documentation, a variable and an output debugging statement.

12
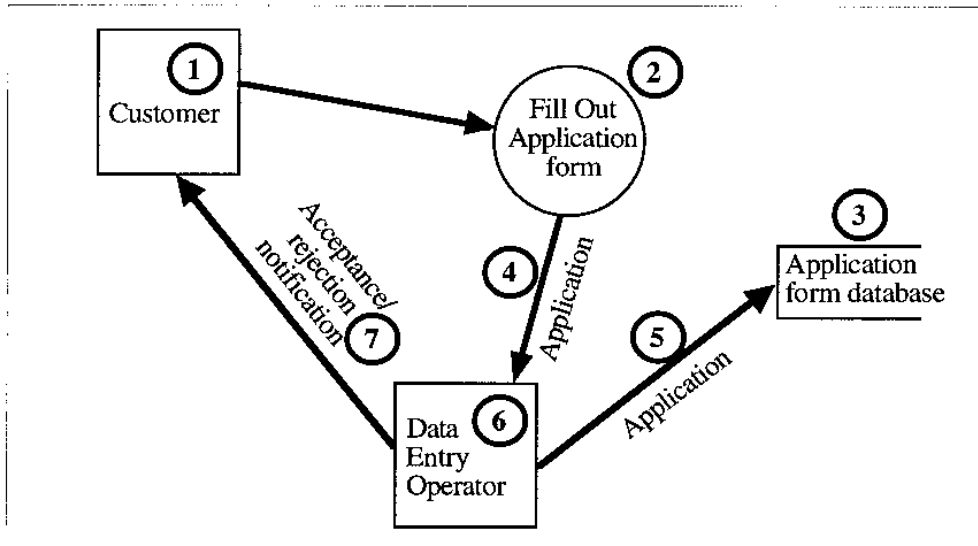
In the above dataflow diagram, an example of a datastore, data item, process and entity, *in that order* is

(A)   3, 5, 2, 6
(B)   5, 4, 2, 3
(C)   3, 5, 7, 1
(D)   6, 2, 7, 3

I3   In constructing a structure diagram, what is the conventional symbol used to show a control parameter?

(A)

(B)

(C)

(D)

14   This question refers to the following algorithm.

```
BEGIN MAINPROGRAM
        Set A to 1
        Set B to 18
        Set C to 0
        Read Number
        WHILE Number < B
                Set B to B - C
                Set C to C + 2
                Set Number to Number + A
                Print Number
        ENDWHILE
END MAINPROGRAM
```

If 2 is used as input data, the output from the algorithm would be

(A)   2, 3, 4, 5, 6, 7
(B)   3, 4, 5, 6, 7
(C)   3, 4, 5, 6
(D)   2, 3, 4, 5, 6

15

(i) set count to 0
     WHILE count < 1000
         set array[count + 1] to 0
         increment count
     ENDWHILE

(ii) set count to 1
      WHILE count <= 1000
          set array[count] to 0
          increment count
      ENDWHILE

(iii) set count to 0
       WHILE count < 1000
           increment count
           set array[count] to 0
       ENDWHILE

Which of the above algorithms perform identical tasks?

(A)   (i) and (ii)
(B)   (ii) and (iii)
(C)   (i) and (iii)
(D)   all of them

16   Which of the following errors could not be detected by exception handling built into a program?

(A) Arithmetic overflow
(B) Errors in logic
(C) Division by zero
(D) Incompatible assignment to variables

17   The development strategy where the problem is refined into smaller subproblems which are then treated as separate problems which may then be further broken down would best be classified as

(A) bottom up design.
(B) top down design.
(C) stub programming.
(D) hierarchical programming.

18   The essential difference between a *file of records* and an *array of records* is

(A) in an array of records all elements must be of the same data type.
(B) a file of records is stored on a secondary storage device.
(C) an array of records can only hold data for one object.
(D) a file of records must be accessed sequentially.

19   A set of test marks have been set up in an array **Test** as shown:

| 32 | 64 | 20 | 84 | 90 | 62 |

If the value of **Test[1]** is 64, what output will be produced by this section of algorithm?

```
value = 5
WHILE value >= 5
        decrease value by 1
        display Test [value]
ENDWHILE
```

(A)   84
(B)   90
(C)   62
(D)   90   84

20   The data structure most often manipulated using a repetition would be

(A)   a record.
(B)   variables.
(C)   an array.
(D)   a string.

Section II - CORE Structured Responses

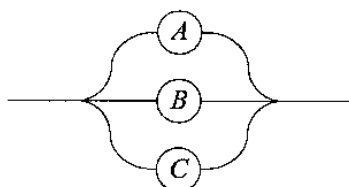**Question 21.** (20 Marks) Start a new sheet of Writing Paper

(a) The software development cycle is fundamental to the Software Design and Development course.

    i) Name in order the FIVE stages of the software development cycle.   2

    ii) Describe why software development can be viewed as a cycle.   1

(b) During the first stage of the software development cycle, a Feasibility Study should be carried out.

    i) Name and describe the FOUR main factors that will determine whether a project is feasible.   4

    ii) If a program is deemed to **not** be feasible, what are the alternatives available to the programmer and project management team?   1

(c) As an accomplished programmer, you have been asked to develop a program to extract data from a compiled database that a company has been using for years. Unfortunately, the program does not allow all fields to be exported, and you do not have access to the original source code of the program. You are also asked to develop a new database to replace the old program.

    i) Describe how reverse engineering could be used in this situation.   1

    ii) What legal and ethical problems does the decision to use reverse engineering pose?   1

    iii) Which software development approach would be most suitable for the development of a new database? Justify your answer.   1

    iv) CASE tools would be ideally suited to the development of the new program. What are CASE tools and how could they be used in this situation?   2

    v) Name the method of implementation that would allow for the company to gradually move one department at a time over to the new system, while other departments continue using the old system.   1

(d) As a computer security consultant you have been asked to help Coca-Cola protect their computer system from viruses. Users and the IT Department have noticed a significant decline in the processing speed of the computers and internal network.

    i) Describe, using a known virus as an example, how computer viruses can be rapidly spread throughout the world.   2

    ii) How could a computer virus affect the processing speed of the computer?   1

    iii) Describe TWO ways that Coca-Cola could prevent viruses from affecting their employee's computers. 1

    iv) The computer programs used by Coke may need to be tested at both the **program** and **system** levels. Differentiate between these two methods of testing.   1

    v) Explain how benchmarking could be used to test whether the computers are operating correctly.   1

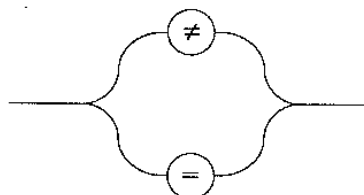**Question 22.** (20 Marks) Start a new sheet of Writing Paper

(a) A large law firm is facing liquidation due to dwindling profits. To solve their problems, the firm has decided that an Internet presence will help them become more competitive and able to offer a better service. One problem they foresee is that any proposed system will take too long to be approved by the board of directors who are not computer literate.

    i) Explain why prototyping would be an appropriate development approach for this problem.   1

    ii) Name and describe ONE project management tool that could be used by the board of directors to track the development of the project.   1

    iii) Employees and clients will be able to view the firm's web site. A restricted section containing confidential information can be accessed by employees when they are not in the office. Clients can only view information about the business including the firm's history, the types of law practised, and a list of lawyers employed by the firm. Clients can also provide details to receive further information. Draw a story board to demonstrate this system.   2

(b) Part of the syntax of a language is given below.
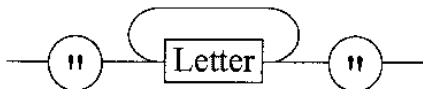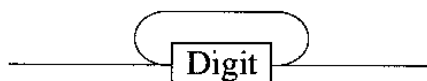
Letter

Symbol

Variable

Number

The following assignment statements are syntactically correct in that language.

        Assign A = "AB" END
        Assign B ≠ 5 END
        Assign C = "BB", B = 4, A = "B" END

    i) Express the syntax of a **Variable** in EBNF.   1

    ii) Draw a 'railroad' diagram for the **assignment statement** in this language.   3

    iii) In terms of language description, differentiate between **operators** and **operands**.   1

(c) A scientist uses a program which calculates the orbit of planets, speed of rotation and other variables. He notices that there are occasional discrepancies in the results of calculations.

    i) Give an explanation of how these errors may have been caused by the programming code.   1

    ii) Suggest how the programming code could be improved to avoid such errors in the future.   1

(d) A computer program allows the users to type in a sentence terminated by a full stop. After a full stop has been read, the user is given three options:

1) Typing U will print out the contents of the array in **UPPER CASE**
2) Typing L will print out the contents of the array in **lower case**
3) Typing T will print out the contents of the array in **Title Case** (ie the first letter of every word is a capital)

These options are repeatedly available until the user types the letter **X** to exit from the program. An algorithm attempting to solve this problem is shown below.

BEGIN MAINPROGRAM
    length = 0
    REPEAT
        read character
        Sentence[length] = character
        add 1 to length
    UNTIL character = "."
    read choice

```
REPEAT
     index = 1
     CASEWHERE choice is
          "U"  :    Print UPPERCASE(Sentence[index])
          "L"  :    Print LOWERCASE(Sentence[index])
          "T"  :    Print TITLECASE(Sentence[index])
     ENDCASE
     index = index + 1
UNTIL choice = "X"
```

END MAINPROGRAM

i) Draw a desk check table and perform a desk check of this algorithm using the test data:

             A qUick TeSt.
             U
             T
             X   2

ii) There are several problems with the algorithm that prevent it from accomplishing the aims described in the problem definition. State the problems with the current algorithm and how they prevent the algorithm from achieving the desired result.   3

iii) Rewrite the section of the algorithm shown in the box, so that it performs the desired task correctly.   2

iv) Design a set of test data that could be used to test that all parts of this algorithm work correctly. Justify the inclusion of the data you have selected.   2

Question 23. (20 Marks) Start a new sheet of Writing Paper

(a)   An interactive program prompts the user several times for the response to questions. The responses need only to be "Y" for yes or "N" for no. The program does allow the user to enter the full word answers "yes" or "no" and this is stored as an answer of "Y" or "N". If the user enters a value other than one of those indicated, they are asked to re-enter their answer until a valid response is given.

    i)   Write an algorithm that will carry out the error trapping and range check described above. The program will not proceed until either the value "Y" or "N" is recorded.   2

    ii)   You have decided to incorporate a Graphical User Interface to make your program more usable. Describe FOUR common components of a GUI.   2

    iii) When designing the interface you remember that there are screen design principles that you should follow. Describe why **fonts, borders** and the **placement of elements** are important to consider when developing an interface.   3

    iv)   What is the difference between event-driven and sequential programming?   1

(b)   The organisers of the Barker Fair have decided that they will be recording the **names** and **ticket numbers** of all people attending the fair. As a person purchases a ticket, their name is entered and a ticket is printed with their name and the ticket number.

The ticket numbers start at 1000 and are incremented by 1 as each ticket is printed. The organisers have decided that every 100th ticket will be a winning ticket, and the word WINNER is printed on the appropriate ticket. Ticket sales are not expected to exceed ticket number 9999. Two sample tickets are shown below:

```
┌─────────────────────────┐   ┌─────────────────────────┐
│                         │   │                         │
│      Barker Fair        │   │      Barker Fair        │
│                         │   │                         │
│  Ticket number: 1052    │   │  Ticket number: 1300    │
│                         │   │                         │
│    Geoff Lancaster      │   │      Leigh Klein        │
│                         │   │                         │
│                         │   │        WINNER           │
│                         │   │                         │
└─────────────────────────┘   └─────────────────────────┘
```
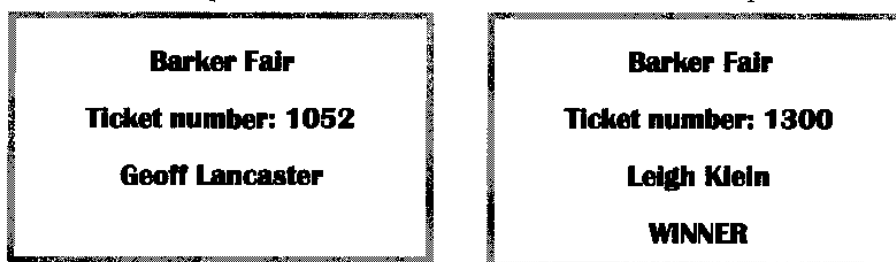
The program stores data in a text file called **FairData**. FairData is an empty text file if the program has not run. When opening the program, data in the text file is loaded into the appropriate data structure and further names and ticket numbers are added. The data is saved to FairData before the program is closed.

The mainline of this program is shown below:

BEGIN MAINPROGRAM
    Load data from file
    Purchase tickets
    Save data to file
END MAINPROGRAM

    i)   Describe the data structures you would use to store the names and ticket numbers of all people attending the Fair within the program. Justify your answer.   2

    ii)   Create a data dictionary to show all of the data items needed to create this program.   2

    iii) Draw an IPO diagram to help explain this program.   2

    iv)   Describe how a sentinel value could be used when reading data in from the text file.   1

    v)   Write an algorithm to carry out the subprogram Load data from file. This will read the data from a text file into the appropriate data structure.   2

    vi)   Write an algorithm to carry out the subprogram Purchase tickets. This will allow the ticket seller to enter names and print tickets. The ticket seller should be able to continue entering names until the name "END" is entered. As each name is entered the ticket number is automatically incremented and a ticket is printed. When "END" is entered as the name, control is passed back to the mainline of the program.   3

Section III - Option Topic - Software Developer's view of the Hardware

Question 24. (20 Marks) Start a new sheet of Writing Paper

(a) i) Copy the following table onto your writing paper and complete the unfilled spaces.   2

|	Binary	Decimal	Hexadecimal
A	10101110		
B		13	
A + B			

ii) Using a 4 bit system, illustrate how two's complement may be used to subtract 3_{10} from 6_{10}.   1

iii) The character A is represented in ASCII as 65 decimal. What character is represented by the binary pattern 01000101?   1

iv) Carry out the following operation using the binary number system. Divide the binary number 1001101 by the binary number 1011, showing all working.   1

v) Represent the decimal number 150.4375 as a 32 bit IEEE floating point number.   2

(b) i) Describe the behaviour of a flip-flop with regard to storage of a single bit of information. Support your answer with EITHER a circuit diagram OR a truth table   2

ii) With the aid of a diagram, explain the role of a half-adder.   1

iii) Draw a truth table for the circuit below, showing the signals at points W, X, Y and Z.   2
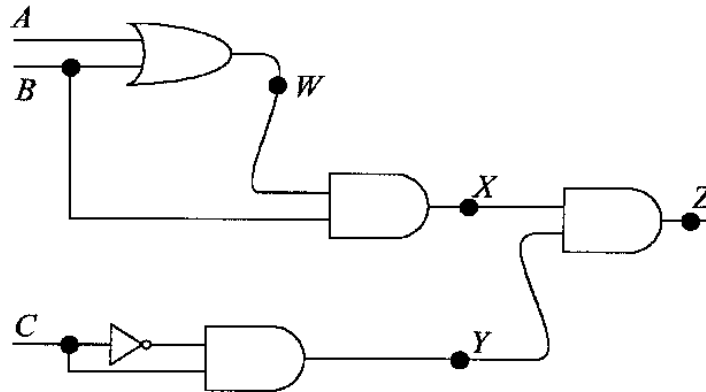
iv) The circuit shown above can be simplified. Draw a simpler circuit to achieve the same result using the least number of logic gates.   1

(c) The Lanklein numeric keypad communicates with the computer by sending packets of data. Each packet contains a start bit, 8 data bits, a parity bit and a stop bit. The data is encoded in ASCII as shown in the table below:

Character	ASCII	Decimal		Character	ASCII	Decimal
0	110000	48		7	110111	55
1	110001	49		8	111000	56
2	110010	50		9	111001	57
3	110011	51		+	101011	43
4	110100	52		-	101101	45
5	110101	53		=	111101	61
6	110110	54				

When the numbers 5 and 1 are entered the contents of the transmitted packets would be:

5   **1**

| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
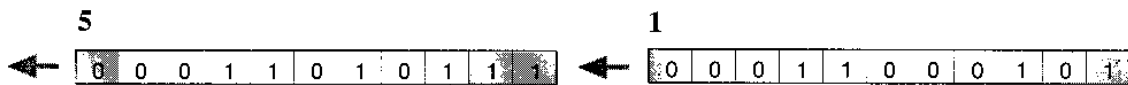
i)   What is the role of a parity bit in data communications?   1

ii) What type of parity checking is used in the example above? Justify your answer.   1

iii) Write down the data stream that would be sent from the Lanklein keypad to transmit "27–8="   1

iv) Explain why the packets transmitted contain redundant data. How could the data be sent in more efficient packets?   1

v)   A simple Calculator program communicates directly with the Lanklein keypad. The algorithm below shows the main control of the Calculator program.

```
BEGIN MAINPROGRAM Calculator
    WHILE Calculator is open
        Read Packets
        Perform Calculation
        Print Result
    ENDWHILE
END MAINPROGRAM


BEGIN SUBPROGRAM Convert to Decimal (Start)
    DecimalNum = 0
    Stop = Start + 6
    Current = Start
    WHILE Current <= Stop
        IF DataStream[Current] = 1 THEN
            DecimalNum = DecimalNum + 2^(Stop - Current)
        ENDIF
        Current = Current + 1
    ENDWHILE
    RETURN DecimalNum
END SUBPROGRAM
```

The <u>Read Packets</u> subprogram will read all of the data entered up until the = sign is entered. (**NB** *you do not have to write this subprogram*) This data stream is read straight into an array called **DataStream**. If the data 51+5= was entered, the contents of the array **DataStream** would appear as shown in the diagram below:

| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 |

From this calculation, the decimal value 56 would be printed to the screen as the result.

The command ASCII(*decimal number*) will convert from a decimal number to it's ASCII character. The subprogram <u>Convert to Decimal</u> can be used to convert a portion of the **DataStream** array into a decimal value.

Your task is to write the subprogram **Perform Calculation**. This subprogram will process and interpret the binary data that has been read into the array and calculate the required result. You can assume that the decimal numbers entered will be less than 100000 (ie up to 5 digits).   3

END OF EXAM

Multiple choice

1 C	2 D	3 D	4 B	5 D
6 D	7 A	8 D	9 D	10 C
11 B	12 A	13 D	14 C	15 D
16 B	17 B	18 B	19 B	20 C

Question 21. (20 Marks) Start a new sheet of Writing Paper

(a) The software development cycle is fundamental to the Software Design and Development course.

    i) Name in order the FIVE stages of the software development cycle.   2

Defining & understanding the problem

Planning and design of solution

Implementation

Testing and evaluation

Maintenance

    ii) Describe why software development can be viewed as a cycle.   1

Work through stages in order and then if system needs to be modified you start from the defining and understanding stage again.

(b) During the first stage of the software development cycle, a Feasibility Study should be carried out

    i) Name and describe the FOUR main factors that will determine whether a project is feasible.   4

Budgetary/Economic - During the financial or budgetary feasibility. the system analyst determines whether the solution to the problem is affordable. This will involve a cost/benefit analysis to determine the initial cost of implementing a solution. the recurring costs of maintaining a working solution and the benefits for the organisation or customer.

Operational - The aim of determining the operational feasibility is to analyse whether a solution will be usable by the target customers. The users of the software solution being produced must be able to effectively use, or operate. the program. It is often necessary to train users to enable the solution to be operationally feasible. The costs of this training must be considered in the cost/benefit analysis.

Technical - To determine the technical feasibility. the analyst must find out what hardware and software is currently being used. The analyst then determines whether the hardware and software to build a workable solution exists. If the solution requires the organisation or customer to purchase new hardware or software. this will impact on the financial feasibility. Software development will be technically feasible if the equipment and software to develop a solution exists. is available and is within the capacity of the organisation to acquire.

Schedule/Time - The schedule feasibility takes into account the time frame in which a solution must be developed. To determine whether a program will be achievable within the specified time frame it is useful to use project planning tools such as Gantt Charts. The software developer must be able to achieve deadlines specified by the customer. The solution being developed must be achievable within an appropriate time frame.

    ii) If a program is deemed to not be feasible, what are the alternatives available to the programmer and project management team?   1

If the solution is determined to not be feasible, the software developer may choose to explore alternative solutions to the problem or may decide to discontinue with the project. They may also choose to scale down the scope of the project.

(c) As an accomplished programmer, you have been asked to develop a program to extract data from a compiled database that a company has been using for years. Unfortunately, the program does not allow all fields to be exported, and you do not have access to the original source code of the program. You are also asked to develop a new database to replace the old program.

    i) Describe how reverse engineering could be used in this situation.   1

The compiled program could be decompiled to produce low level source code. The process is made simpler through the use of CASE tools which may help to provide some structure to the decompiled code. This source code could then be modified and recompiled to allow export access to all fields.

    ii) What legal and ethical problems does the decision to use reverse engineering pose?   1

It is legal to decompile the programming code if there is no other way to get the required info from/about the program. It would be faaster and beitter to track down the original developer to try to get an original source code copy of the program. If the company is the sole owner of the database and they had it custom built for them originally (or built in-house). there is not much of an ethical problem. However if the database is quite

standard and is used by a lot of companies. the company would only have a licence and would therefore have greater legal and ethical problems.

    iii) Which software development approach would be most suitable for the development of a new database? Justify your answer.   1

RAD seems the obvious choice because it would be a fairly standard type of database program. RAD would allow the software developer to integrate a number of standard modules with any custom code required to achieve specific functions required by the organisation. RAD would also allow for te program to developed cheaply and quickly. It could not be end-user as they have asked a software devcloper to do it for them. Would not be structured unless you specified that the company is big and that they require the code to be tight. Prototyping would not be used unless you were developing the program from a stndard sort of package like MS Access...

    iv) CASE tools would be ideatly suited to the development of the new program. What are CASE tools and how could they be used in this situation?   2

CASE tools - Computer Aided Software Engineering tools allow software developers to automate many aspects of the process of software development. CASE tools are a collection of resources that provide planning, analysis. and design facilities. as well as the ability to automatically generate segments of code. They often provide support for maintenance of software that has been developed.

In this situation they would most likely be used to pull together standard modules of code. They could also be used to produce documentation or carry out testing on the modulkes and the complete system.

    v) Name the method of implementation that would allow for the company to gradually move one department at a time over to the new system, while other departments continue using the old system.   1

Phased conversion

(d) As a computer security consultant you have been asked to help Coca-Cola protect their computer system from viruses. Users and the IT department have noticed a significant decline in the processing speed of the computers and internal network.

    i) Describe, using a known virus as an example, how computer viruses can be rapidly spread throughout the world.   2

Traditionally viruses have spread from computer to computer through the sharing of floppy disks that are infected. More recently. viruses have spread through the use of email. This has enabled viruses to spread throughout the world very rapidly. The I Love You virus (which was first seen in 2000) is passed on as an attachment to email. The email indicates that the attached file called 't Love You' is a special message from a friend. When opened. the virus attaches itself to system files and changes the name of many files. It uses the host computers email address book to send an infected email to all addresses listed in the address book. When the computer is rebooted, the virus program also searches for passwords and sends them to and internet site for later use.

    ii) How could a computer virus affect the processing speed of the computer?   1

A computer virus could affect the computers speed in a number of ways. One way is that the virus program may take up a lot of processor time actually running the virus. The program may be automatically be open on startup and carrying out tasks in the background while you are trying to do other tasks. Another way is that the virus when initially run may insert extra bits of code into program on the computer so that inefficiencies happen. Alternatively. the virus program developer may have written code which only tries to waste processing time (eg a loop that doesnt achieve anything much)

    iii) Describe TWO ways that Coca-Cola could prevent viruses from affecting their employee's computers.   1

Install and regularly update virus checking software on all computers. This will only be effective if the user run the virus scan on all emails and disks used. Educate employees.

Filter emails and attachments received by employees so that the threat of email viruses is greatly reduced.

Use a firewall or something to scan programs being downloaded from the internet.

    iv) The computer programs used by Coke may need to be tested at both the program and system levels. Differentiate between these two methods of testing.   1

Program testing test the correct operation of the program and all its modules. System testing is carried out to detect errors at the software/hardware interface. including testing the program in possible operating systems etc.

    v) Explain how benchmarking could be used to test whether the computers are operating correctly.   1

Benchmarking could be used to test each system against a known good (uninfected) computer. The same programs could be run and operating speeds recorded and compared.

Question 22. (20 Marks) Start a new sheet of Writing Paper

(a) A large law firm is facing liquidation due to dwindling profits. To solve their problems, the firm has decided that an Internet presence will help them become more competitive and able to offer a better service. One problem they foresee is that any proposed system will take too long to be approved by the board of directors who are not computer literate.
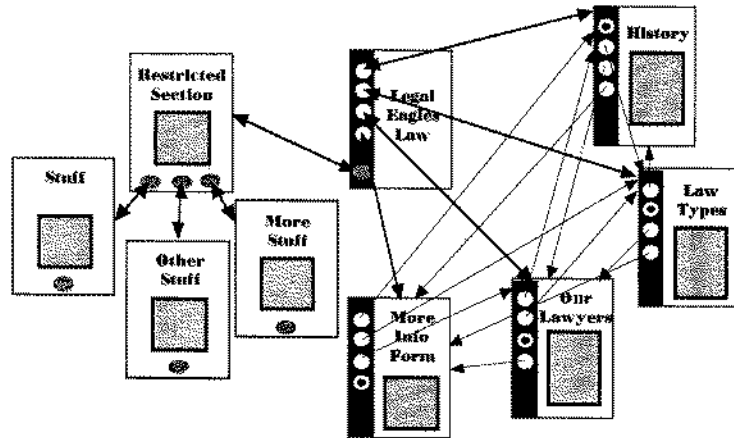
  i) Explain why prototyping would be an appropriate development approach for this problem.   1

Prototyping is well suited to program which have a high interface component. Web sites have fairly simple processing with the main emphasis being on the appearance so they are ideally suited to prototyping. Prototyping will also allow the board of directors to be involved in the development and approve the project through it's various stages of development.

  ii) Name and describe ONE project management tool that could be used by the board of directors to track the development of the project.   1

Gantt chart - The project managers and development team could all contribute to a Gantt chart to ensure that tasks are carried out in the timeframes nominated. This keeps the development team accountable and ensures the management don't have unrealistic expectations of what the developers should have achieved in a certain period of time.

  iii) Employees and clients will be able to view the firm's web site. A restricted section containing confidential information can be accessed by employees when they are not in the office. Clients can only view information about the business including the firm's history, the types of law practised, and a list of lawyers employed by the firm. Clients can also provide details to receive further information. Draw a story board to demonstrate this system.   2
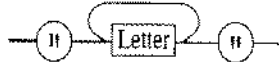

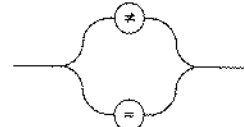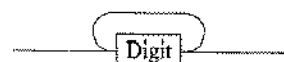(b) Part of the syntax of a language is given below.

Letter

Symbol

Variable

Number

The following assignment statements are syntactically correct in that language.

    Assign A = "AB" END
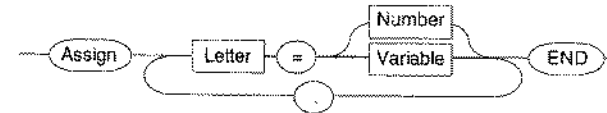   Assign B ≠ 5 END
    Assign C = "BB", B = 4. A = "B" END

  i) Express the syntax of a Variable in EBNF.   1

<variable> = " <letter> {<letter>} "

  ii) Draw a 'railroad' diagram for the assignment statement in this language.   3
Assignment statement

  iii) In terms of language description, differentiate between operators and operands.   1

operator - The names of actions or functions that are used to carry out an operation. They specify what operation is to be performed on the operands.

operand - The item in an operation which is used to achieve the result. An operand is any sequence of symbols that reduces to a single value. Variables and constants are examples of operands.

(c) A scientist uses a program which calculates the orbit of planets, speed of rotation and other variables. He notices that there are occasional discrepancies in the results of calculations.

  i) Give an explanation of how these errors may have been caused by the programming code.   1

Could be a rounding error. Precision of storage method (eg 32 bit real or even 128 bit real) may not be accurate enough when alot of calculations need to be performed.

  ii) Suggest how the programming code could be improved to avoid such errors in the future.   1

Higher precision variables could be used. Could possibly use BCD (Binary Coded Decimal) as used on mainframes etc - this would allow no rounding.

(d) A computer program allows the users to type in a sentence terminated by a full stop. After a full stop has been read, the user is given three options:

  1) Typing U will print out the contents of the array in UPPER CASE
  2) Typing L will print out the contents of the array in lower case
  3) Typing T will print out the contents of the array in Title Case (ie the first letter of every word is a capital)

Theses options are repeatedly available until the user types the letter X to exit from the program. An algorithm attempting to solve this problem is shown below:

```
BEGIN MAINPROGRAM
    length = 0
    REPEAT
        read character
        Sentence[length] = character
        add 1 to length
    UNTIL character = ".."
    read choice
    REPEAT
        index = 1
        CASEWHERE choice is
            "U" :   Print UPPERCASE(Sentence[index])
            "L" :   Print LOWERCASE(Sentence[index])
            "T" :   Print TITLECASE(Sentence[index])
        ENDCASE
        index = index + 1
    UNTIL choice = "X"
END MAINPROGRAM
```

i) Perform a desk check of this algorithm using the test data:

A qUick TeSt.
U
T
X

length	character	sentence	choice	index	output
0	A	Sentence[0] = A			
1	space	Sentence[1] = " "			
2	q	Sentence[2] = q			
3	U	Sentence[3] = U			
4	i	Sentence[4] = i			
5	c	Sentence[5] = c			
6	k	Sentence[6] = k			
7	space	Sentence[7] = " "			
8	T	Sentence[8] = T			
9	e	Sentence[9] = e			
10	S	Sentence[10] = S			
11	t	Sentence[11] = t			
12	.	Sentence[12] = .			
13			U	1	
				2	space
				1	
				2	space
				1	
				2	space
				this continues forever	

ii) There are several problems with the algorithm that prevent it from accomplishing the aims described in the problem definition. State the problems with the current algorithm and how they prevent the algorithm from achieving the desired result.   3

1 - Only lets you enter a choice once so it will be in an infinite loop. The question says they must be able to enter a few different choices

2 - Will only print element 1 from the array - keeps resting index to be 1.

3 - Will not print the first letter as first entry stored in array element 0 but start printing from element 1.

iii) Rewrite the section of the algorithm shown in the box, so that it performs the desired task correctly.   2

```
REPEAT
    index = 0
    read choice
    CASEWHERE choice is
        " U " :  WHILE index < length
                    Print UPPERCASE(Sentence[index])
                    index = index + 1
                 ENDWHILE
        " L " :  WHILE index < length
                    Print LOWERCASE(Sentence[index])
                    index = index + 1
                 ENDWHILE
        " T " :  WHILE index < length
                    Print TITLECASE(Sentence[index])
                    index = index + 1
                 ENDWHILE
    ENDCASE
UNTIL choice = "X"
```

iv) Design a set of test data that could be used to test that all parts of this algorithm work correctly. Justify the inclusion of the data you have selected.   2

Sentence	Choice	Reason
A qUick TeSt.		Sentence which is not one of the three options so is clear if it works.
	U	Tests Uppercase
	T	Tests title case
	L	Tests lowercase
	X	checks finishes OK
Try tHiS		No terminating condition so won't work
A qUick TeSt. And some more.		Tests doesn't read in more than one sentence