DOONSIDE TECHNOLOGY HIGH SCHOOL

COMPUTING FACULTY

2001
HIGHER SCHOOL CERTIFICATE
TRIAL EXAMINATION

Software Design and Development

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using blue or black pen
- Write your student number and/or name at the top of every page

Section I

Total marks (20)

- Attempt questions 1-20
- Allow about 35 minutes for this section
- Mark your answers on the answer sheet provided

Section II

Total marks (60)

- Attempt questions 21-23
- Allow about 1 hour and 50 minutes for this section
- Answer in the spaces provided on this paper

Section III

Total marks (20)

- Attempt either Question 24 or Question 25
- Allow about 35 minutes for this section
- Answer on a *separate* piece of paper

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

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1. A major manufacturer of gaming hardware and software has found their market position to be dropping rapidly since the release of new, more powerful machines from one of their competitors. They are aware of the need to create a machine that will revolutionise the gaming market, allowing the company to regain its market share. Which of these feasibility constraints would be of most concern to them:

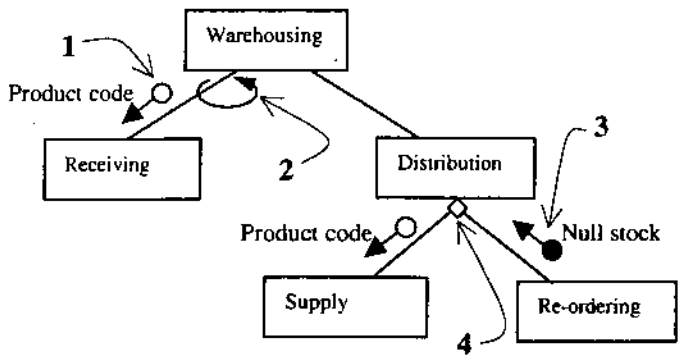
   (A) Budgetary
   (B) Operational
   (C) Scheduling
   (D) Technical

2. A game is currently being developed. From the user's perspective the game contains 15 levels. From the software developer's perspective this is not really the case. Levels 1-4 actually execute the same code. Similarly Levels 5-9, Levels 10-14 and Level 15 execute separate unique sub-programs.

   The most appropriate control structure for implementing this branching would be:

   (A) pre-test repetition
   (B) post-test repetition
   (C) multiway selection
   (D) binary selection

3. The constructs denoted at **1**, **2**, **3** and **4** on the structure diagram below are:



   (A) **1** – process, **2** – repetition, **3** –parameter, **4** – call line
   (B) **1** – parameter, **2** – repetition, **3** – control parameter, **4** - decision
   (C) **1** – parameter, **2** – call line, **3** – control parameter, **4** - decision
   (D) **1** – flag, **2** – decision, **3** – control parameter, **4** - repetition

4. A file processing technique, which allows the greatest flexibility for variation in file length, is to use a:
   (A) Constant
   (B) Parameter
   (C) Sentinel
   (D) Variable

Refer to the following combination box when answering Questions 5 and 6.

5. The combination box above is used to ensure users only select a school name from those available in the drop down list box. From the developer's viewpoint, which of the following terms best describes the process performed by this combination box?
   (A) Data integrity check
   (B) Data validation
   (C) Data redundancy check
   (D) Menu selection

6. Items can be selected in the above combination box by entering text. If a "b" is entered, all the first school commencing with "b" is selected. If an "e" is then entered the first school, commencing with "be" is selected.

   The code performing this task would mostly likely be based on a:
   (A) linear search
   (B) binary search
   (C) bubble sort
   (D) selection sort

7. In which phase of the structured approach to software development is the user interface created and code documentation completed?
   (A) planning and design
   (B) implementation
   (C) testing and evaluation
   (D) maintenance

8. A retail business contracts a software development company to design software specific to their needs. This is called:
   (A) end user development
   (B) custom design
   (C) outsourcing
   (D) prototyping

9. "Keep 'm Quiet Software" is a beginning company and has recently developed a program designed for young children. It decides to distribute this software free on a trial basis. This software would best be described as:

(A) freeware
(B) shareware
(C) postcardware
(D) public domain

10. A software company introduces a software package into the marketplace. The package is designed for a specific and small portion of the market. The product would be considered to be:

(A) a market leader
(B) a market challenger
(C) a market follower
(D) filling a market niche

11. The following are all valid forms of the input statement in a particular version of BASIC.

```
INPUT A$
INPUT "Please enter your name..."; Name$
INPUT "Enter name, age and gender", Name$, Age, Gender
INPUT A$(4,8)
```

Which of the following EBNF statements best specify the syntax of the INPUT statement?

(A)
```
statement = INPUT [<prompt>] (;|,) <variable> {,<variable>}
prompt = "<letter>|<digit>|<symbol>{<letter>|<digit>|<symbol>}"
variable = <letter>{<letter>|<digit>}[$] [<dimension>]
dimension = (<variable>|<number>{,<variable>|<number>})
```

(B)
```
statement = INPUT [<prompt>] <variable>
prompt = "<letter>|<digit>|<symbol>{<letter>|<digit>|<symbol>}"
variable = <letter>{<letter>|<digit>}[$] [<dimension>]
dimension = (<variable>|<number>)
```

(C)
```
statement = INPUT [<prompt>] (;|,) <variable> {,<variable>}
prompt = "<letter>|<digit>|<symbol>{<letter>|<digit>|<symbol>}"
variable = <letter>{<letter>|<digit>}[$] [<dimension>]
dimension = (<variable>{,<variable>})
```

(D)
```
statement = INPUT <variable> {,<variable>}
prompt = "<letter>|<digit>|<symbol>{<letter>|<digit>|<symbol>}"
variable = <letter>{<letter>|<digit>}
dimension = <variable>|<number>{,<variable>|<number>}
```

12. A student examines the source code of an old game she has at home to understand its workings. Her intention is to create a program that will interface with this game. This process is called

(A) backwards chaining
(B) reverse engineering
(C) decompilation
(D) plagiarism

13. Following are machine code instructions for a particular CPU

`IPT`	input a 2 byte binary ASCII code from the keyboard into the address specified.
`LR`	load the specified register with the data held in an address.
`CMR`	compares the contents of the two registers, and stores the largest value in the first register
`SR`	copy the contents of the given register into the given address
`PR`	display the contents of the specified address.

The following machine code fragment is written

```
IPT   2003
IPT   2005
LR    01, 2003
LR    02, 2005
CMR   02,01
SR    02, 2003
PR    2003
```

If the data 3, 2 is input, what is the resultant output?

(A) 2
(B) 3
(C) 2003
(D) 2005

14. The role of the program counter in the fetch-execute cycle is to

(A) count the number of instructions that have been processed
(B) specify the number of bytes to be fetched from RAM
(C) count the number of programs currently in RAM
(D) hold the address of the next instruction to be executed

15. An inexperienced new user of a recently developed software product would be most likely to need to refer to the

(A) data dictionary , tutorial and installation guide
(B) user manual, system flowcharts and source code
(C) algorithms, reference manual and process diary
(D) user manual, tutorial and on-line help

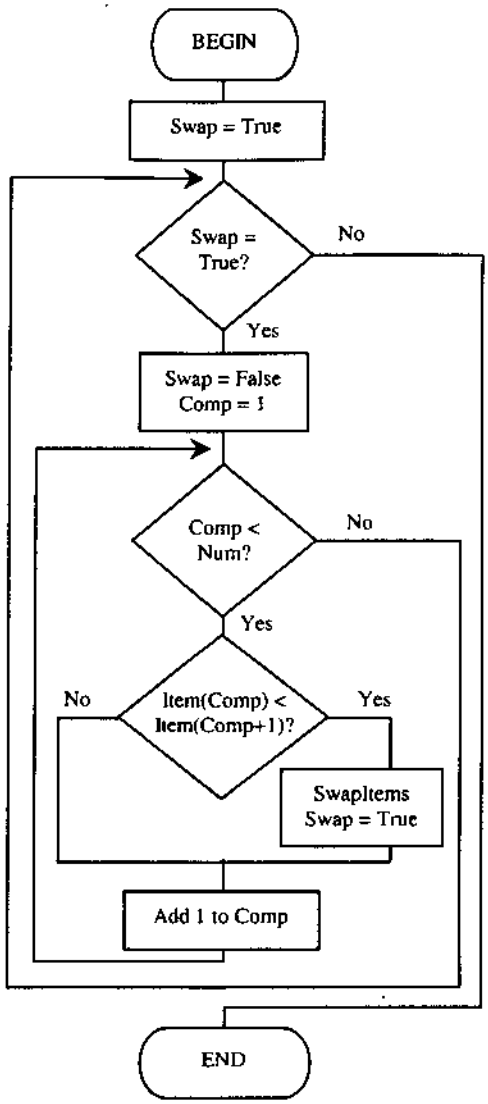
16. When developing a new piece of software, the most appropriate order for a variety of testing procedures would be

(A) structured walkthrough, test data, peer check
(B) desk check, peer check, systems test, volume test data
(C) eliminate run time errors, remove syntax errors, acceptance testing
(D) use of CASE tools, testing report, module test, volume test data

Refer to the flowchart at right when answering Questions 17, 18, 19 and 20.

17. This flowchart is an implementation of a(n):

(A) insertion sort
(B) selection sort
(C) bubble sort
(D) quick sort



18. Which identifier could be classified as a flag?

(A) Swap
(B) Comp
(C) Item
(D) Num

19. Presumably a subroutine exists to perform the SwapItems process. This process could contain the lines:

(A) Item(Comp) = Item(Comp + 1)
Item(Comp + 1) = Item(Comp)

(B) Item(Comp) = Item(Comp + 1)
Temp = Item(Comp)
Item(Comp + 1) = Temp

(C) Temp = Item(Comp)
Item(Comp + 1) = Item(Comp)
Item(Comp) = Temp

(D) Temp = Item(Comp)
Item(Comp) = Item(Comp + 1)
Item(Comp + 1) = Temp

20. What are the bounds for the index of the array "Items"

(A) 0 to Num
(B) 1 to Num
(C) 0 to Num + 1
(D) 1 to Num + 1

TRIAL EXAMINATION

2001

Software Design and Development

Section I. Multiple Choice Answer Sheet.

Place a cross in the box that corresponds to the best answer.

Question	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
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12				
13				
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15				
16				
17				
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19				
20				

Section II

Total marks (60)
Attempt Questions 21 – 23
Allow about 1 hour and 50 minutes for this section

Answer in the spaces provided on this paper.

If you include diagrams in your answer, ensure they are clearly labelled.

Question 21. (20 marks) **Marks**

(a) PBC High School is currently using a computer system in the administration section of the school. This system is not performing the way the school would like and they now are in the process of developing a new system. A systems analyst has been employed to assist with the development of the new system. As part of the process the analyst discusses with the school the parallel and phased methods of conversion.

(i) Discuss the advantages and disadvantages that the analyst may present for EACH method of conversion. 3

(ii) Explain the factors that should be considered when drawing up the licencing agreement between the school and the software development company. 3

(iii) Describe the documentation that needs to be created by the analyst's company before the implementation of the solution commences. 3

(b) When using CASE tools it is possible to track the changes that are made to a program, this is termed versioning. An operating system has progressed through the following versions: 3

OS8, OS8.1, OS8.1.1, OS8.2, OS9

Discuss the general nature of the changes that have occurred in the software as it has progressed from OS8 to OS9.

(c) An Interstate bus company travels between Sydney and Melbourne. Along the route it collects passenger's at designated terminals. The bus company decides that at each terminal a touch screen will be installed as quickly as possible. The screen will provide the following information:

- a timetable for all their buses
- the estimated time of arrival of all buses currently on-route.

(i) Describe the software development approach that would be most suited to this project. Justify your answer with reasons. 2

(ii) Identify the constraints that would need to be considered in determining the technical feasibility of this system. 2

(iii) Create a context diagram for one of the touch screen terminals. 2

(iv) Discuss the methods by which the quality of this product could be assessed. 2

End of Question 21

Question 22. (20 marks) **Marks**

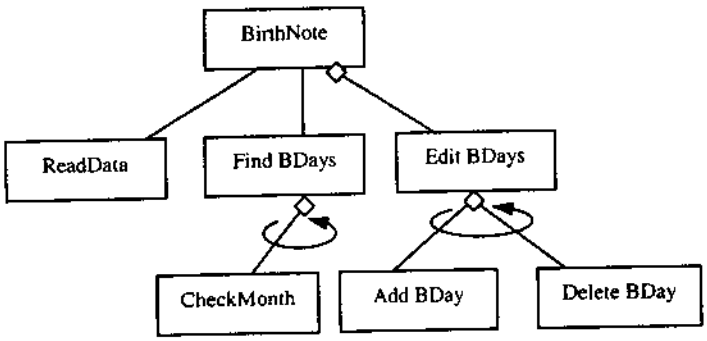
(a) A birthday notification system is currently under development. Essentially the program will display a list of people who have birthdays within the current month.

The data for this system is read from a text file containing names and birthdates. A sample file is reproduced below:

```
Johnno,14,6,1983
Smithy,27,11,1984
Jen,2,1,1990
Margy,17,8,1977
```

(i) Design and describe a possible data structure that could be used to store the data retrieved from the text file. Justify your choice of data structure. 3

(ii) The following structure diagram is being developed to describe the connection between sub-routines within the program. 4



Describe, in words, the processing modeled by the above structure diagram.

(iii) The IPO chart that follows describes the processing required by the "Delete BDay" process.

IPO CHART for the DeleteBDay process		
Input	Process	Output
Name	Find name in array	
	Set flag to true if found or false if not found	True or False
	Store the index of this item	
	Move lower items up 1	
	Decrement number of items	

1. Create an algorithm using either pseudocode or a flowchart to accomplish this task. Your algorithm should use the data structure you designed in part (i). 4

2. Would the `DeleteBDay` process be best implemented as a sub-program or as a function? Justify your answer. 2

3. Parameters are vital to "top-down design" methodology. What are parameters and how do they assist the top-down design process? Use the `DeleteBDay` process to illustrate your answer. 3

Question 22 continues on the next page

(b) Testing of software solutions occurs throughout the software development cycle. However, the use of live test data is usually performed once the final product is operational. 2

(i) What is live test data and how does it differ from other types of test data?

(ii) Live test data is often used to test and evaluate particular possible scenarios. Describe TWO different scenarios that may be tested using live test data. In each case describe the nature of the test data set. 2

End of Question 22

Question 23. (20 marks) **Marks**

The following scenario is to be used for parts (a) to (e).

You have been asked to design and develop a program which will test students in Year 7 on their French vocabulary. There are 40000 words they need to be tested on, categorised into easy, harder, difficult and challenging categories, with 10000 words in each category.

You have been directed to store the words in a relative file on disk (called WORDS), rather than processing them in an array in memory, as there are concerns as to both the memory and processing speed required for an array-based solution.

(a) Why do you think a relative file has been specified for this task? Describe your choice of structure and order of the records within this WORDS file. 2

(b) Design an algorithm, in pseudocode, to print a random word from the correct category on the screen, and ask for its English equivalent translation. If the translation is correct, print the message "well done", otherwise print the correct translation. 4

(c) Draw a storyboard for the French program, labelling good design elements. 3

(d) Assume that you now wish to make use of a new hardware device which will 'read' and pronounce the words in a French accent as they are displayed. This device is radically different from current voice synthesisers, and uses quite different logic from any current device. 3

Describe all of the steps and resources required to allow your program to be able to use this device.

(e) The following EBNF definitions define the verbs to generate a random number, and to read a relative file in a particular language. 4

Read a record:
`GET <variable> FROM <variable> USING <variable>`
where
`GET input_rec FROM stock_file USING part_no`
reads the `part_no`'th record from `stock_file` into the variable called `input_rec`.

Random number generator:
`<variable> = RND(<value>) + <value>`
where `RND(10)` returns an integer value from 1 to 10

Screen display:
`OUTPUT <variable> at <value>, <value>`

Other required definitions:
```
Letter = _|.|a|b|c|d|e|f|g|….|x|y|z
variable = <Letter>{<Letter>}
digit = 0|1|2|3|4|5|6|7|8|9
value = <digit>{<digit>}
```

Write a series of statements to generate the next challenging French word to be displayed at a position 100 across and 250 down.

Question 23 continues on the next page

(f) Debugging code can be a frustrating task. Fortunately there are many techniques and tools available to assist programmers to isolate errors in their code. Name and describe the techniques or tools available to assist in the location of errors in source code. 4

End of Question 23

Section III

Total marks (20)
Attempt either Question 24 or Questions 25
Allow about 35 minutes for this section

Answer the question on a SEPARATE piece of paper.
If you include diagrams in your answer, ensure they are clearly labelled.

Question 24 – Evolution of Programming Languages (20 marks) **Marks**

(a) In this Option you have studied three new paradigms. Discuss the historical reasons for the development of new programming paradigms. As part of your discussion explain why Object Oriented languages have become so popular when languages based on the Logical and Functional paradigms remain uncommon. 4

(b) The logic paradigm is based on facts and rules. Consider the following series of facts and rules.

Facts

1. mike is a deeg
2. bill is a deeg
3. mary is a roon
4. fran is roon
5. sam is a roon

Rules

1. If A is a deeg and B is a roon then A can joop B
2. If A can joop B then B can joop A
3. If A can joop B and B can joop C then C can joop A

Use the above facts and rules to answer the following. In each case explain your reasoning logically using only the given facts and rules. 6

(i) Can a roon ever joop a deeg?

(ii) Who can mike joop?

(iii) Is it possible for someone to joop themselves?

(iv) Discuss the meaning of the terms backward and forward chaining. Give an example of each using the facts and rules above.

Question 24 continues on the next page

(c) Motor vehicles are a good example of object-oriented design. Each time a new car is designed it is not necessary to design new tyres or new brake pads or even a new engine, rather many of the parts are reused from previous vehicles. These parts have been thoroughly tested and can be used in the new model with confidence. 6

Explain the meaning of each of the following object-oriented terms. Use aspects of the design of motor vehicles to provide an example to assist your explanation.

(i) class

(ii) inheritance

(iii) encapsulation

(iv) polymorphism

(d) Programs written using functional programming languages are often significantly shorter than similar programs written in other languages. 4

(i) Why is this the case? Explain.

(ii) If the code is so short then why aren't we all using functional languages? Explain and justify.

Question 25 – Software Developer's View of the Hardware (20 marks) **Marks**

(a) The ASCII value for A is 65. What would the text string 'FaCe' look like as stored in memory, expressed in hexadecimal format? 3

(b) Using an 8-bit binary system, what decimal value does the bit string 10110111_2 represent? 2

(c) What is the maximum range of numbers that can be expressed using a 3 bit two's complement binary number system? Demonstrate your answer using a table of values. 2

(d) Using the 'shift and subtract' method and the binary number system calculate 74 divided by 5. 2

(e) The IEEE single precision floating point standard has been accepted and implemented within the floating point unit (FPU) of most modern microprocessors.

(i) Convert 24.25_{10} to the IEEE single precision floating point standard representation, and verify your answer by converting it back to its decimal representation. 3

(ii) Explain the role of the exponent and bias 2

(f) Design a circuit with 3 inputs which will only output a 1 value if the third input OR the first two inputs are 1. If all 3 inputs are one, a zero is to be produced. Confirm your answer with a truth table 4

(g) Describe how flip-flops are able to store binary digits. 2

END OF EXAMINATION