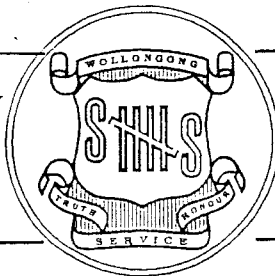


Smith's Hill



High School

Promoting excellence in a spirit of trust and co-operation

2099

2002

TRIAL EXAMINATION

Software Design and Development

Total marks - 100

Section I

Total marks (20) Pages 2 - 6

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

Section II

Total marks (60) Pages 7 - 21

- 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) Pages 21 - 25

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

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

STUDENT NUMBER/NAME: 11992099

TRIAL EXAMINATION

2001

Software Design and Development

Student Name/Number:11992099.....

Section I. Multiple Choice Answer Sheet.

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

13

Question	A	B	C	D
1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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9	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
12	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
14	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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18	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
19	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

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

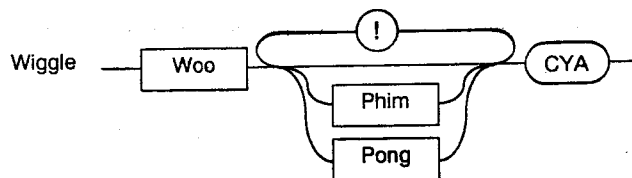
Use the multiple choice answer sheet

Select the alternative A, B, C or D that best answers the question

1. When is the use of customised off-the-shelf software appropriate?
 - (A) when there is not time to develop the source code from scratch
 - (B) when there is a relevant product available that can be ethically and economically modified
 - (C) when it is cheaper to purchase an application package
 - (D) when there is no one in the company with the skills to develop the package themselves

2. What does a structure diagram show?
 - (A) media and the separate processes used in the system
 - (B) the structure of an individual program within a complete system
 - (C) subtasks, their relationships, and the data passed between them
 - (D) people, storage, separate processes and data passed between them

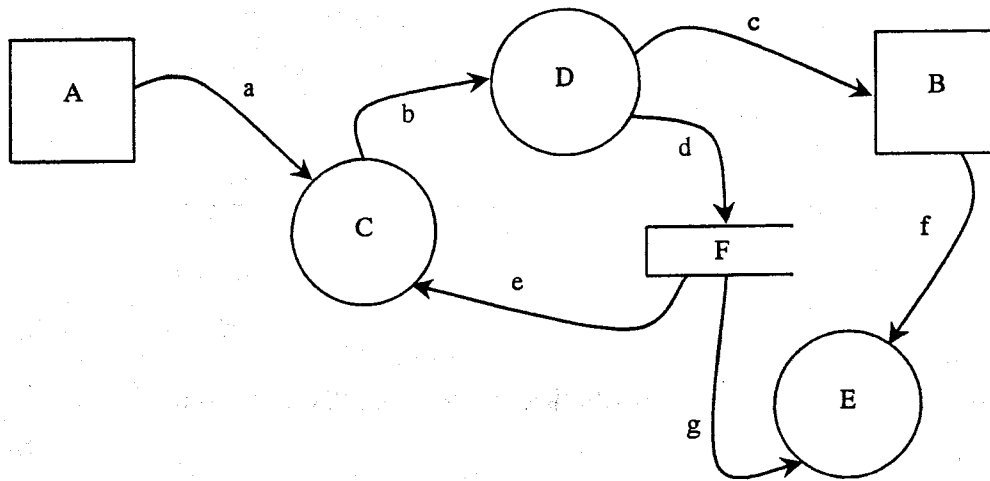
Refer to the following railroad diagram when answering Questions 3 and 4.



3. On this railroad diagram:
 - (A) CYA is defined elsewhere, whereas Woo, Phim and Pong are non-terminal symbols.
 - (B) Woo, Phim and Pong are defined elsewhere, whereas CYA is a non-terminal symbol.
 - (C) CYA is defined elsewhere, whereas Woo, Phim and Pong are terminal symbols.
 - (D) Woo, Phim and Pong are defined elsewhere, whereas CYA is a terminal symbol.

4. In EBNF, the above railroad diagram could be written as:
 - (A) Wiggle = <Woo> {<Phim>|<Pong>|!} CYA
 - (B) Wiggle = <Woo> [<Phim>|<Pong>] {<Phim>|<Pong>|!} CYA
 - (C) Wiggle = Woo [Phim | Pong | !] { [Phim | Pong] | <!> } CYA
 - (D) Wiggle = <Woo> [<Phim>|<Pong>] { ! [<Phim>|<Pong>] } CYA

Refer to the following diagram when answering Questions 5, 6 and 7.



5. The above diagram can be best described as:
 - (A) a system flowchart
 - (B) a context diagram
 - (C) a data flow diagram
 - (D) a system model

6. Which of the following is true?
 - (A) A and B are processes. C, D and E are external entities. F is a data store. a – g show data movements.
 - (B) A and B are external entities. C, D and E are processes. F is a data store. a – g show data movements.
 - (C) A and B are sinks. C, D and E are sources. F is an external entity. a – g are call lines.
 - (D) A and B are processes. C, D and E are modules. F is a file. a – g are call lines.

7. There are problems or errors on the above model. Which statement describes the most significant problem?
 - (A) D provides feedback, via F, to C.
 - (B) E could be removed without affecting the solution.
 - (C) B provides both input and output, this is not allowed.
 - (D) No parameters are shown.

8. Which type of sort uses a shuffle process to place the next unsorted element in its correct position in the sorted part of the array?
- (A) shell sort
 - (B) bubble sort
 - (C) selection sort
 - (D) insertion sort
9. What could cause a syntax error?
- (A) inappropriate use of a reserved word
 - (B) arithmetic overflow
 - (C) not setting the appropriate condition before entering a pre-test loop
 - (D) use of the statements
Let count = 0
Let average = total / count
10. If a program is required to be able to locate a particular (user determined) value within a large, ordered array, the most appropriate algorithm for this action would be a:
- (A) selection sort
 - (B) insertion sort
 - (C) binary search
 - (D) linear search
11. A developer may use a storyboard to:
- (A) help define the boundaries of the problem
 - (B) assist in the design of the user interface
 - (C) describe the logic of the solution
 - (D) represent the complexity of the software solution
12. The RAD approach to software development is characterised by:
- (A) a strict sequence of events resulting in high quality products.
 - (B) the use of reusable components and fast development times.
 - (C) customisation of existing applications.
 - (D) the use of CASE tools and specialised personnel.

13. Tests to ensure the solution performs with large files or large volumes of input would form part of:
- (A) algorithm testing.
 - (B) module level testing.
 - (C) program testing.
 - (D) system level testing.
14. In the correct sequence, the THREE essential processes when translating source code into executable code are:
- (A) lexical analysis, syntactical analysis and code generation.
 - (B) syntactical analysis, lexical analysis and code generation.
 - (C) interpretation, compilation and incremental compilation.
 - (D) code creation, code generation and code execution.
15. A software product distributed as shareware in most cases:
- (A) can be freely copied, distributed and altered.
 - (B) includes the source code so future programmers may use routines within their own products.
 - (C) can be freely copied and distributed but not altered.
 - (D) cannot be installed and used until the licence fee has been paid.
16. Claiming a section of code to be your own when in fact someone else created it could be best described as:
- (A) stealing.
 - (B) a copyright infringement.
 - (C) plagiarism.
 - (D) reverse engineering.
17. The CPU contains a register known as the program counter. Which statement best describes the program counter?
- (A) Storage area for the next instruction prior to its execution, this includes not just the instruction but also its associated operands. Each instruction is fetched in turn and stored in the program counter.
 - (B) Maintains a record of the line number of the currently executing instruction. As programs are sequential the program counter is merely incremented after the instruction has been executed.
 - (C) Stores the address in memory of the next instruction to be executed. It is called a counter as in most cases instructions are executed sequentially so the program counter is merely incremented.
 - (D) The system needs to know which program is currently using the resources of the CPU. The program counter holds a binary code indicating the program that currently has control and is executing within the CPU.

Refer to the fictitious source code below when answering Questions 18, 19 and 20.

Define

Range as [1 ... 10] of int.
 Domain as [0 ... 5] of int.
 Temp of Domain.
 DeviceType using
 Desc of char(Range)
 Cost of int
 Stock of bool.
 Device(Domain,Domain) of DeviceType.

Const

cDevice of DeviceType
 Set Desc to Null
 Set Cost to 0
 Set Stock to False.

Begin

ForEach Domain
 Set Device(Domain,Domain) to cDevice.

Main

ForEach Domain
 ForEach Temp
 Using Device(Temp,Domain)
 Set Cost to Input...

18. What type of data structure is Device?
- (A) A 2 dimensional array containing 12 elements.
 - (B) A record containing 3 fields, one of which is an array.
 - (C) A 2 dimensional array of 36 records.
 - (D) A 2 dimensional array of 25 records.
19. Which of the following lists contain only identifiers?
- (A) Device, cDevice, Domain, Range, Temp
 - (B) Define, Const, Begin, Main
 - (C) char, int, bool, DeviceType
 - (D) Set, ForEach, to, as, of
20. The best description of the processing occurring is:
- ×(A) Device is initialised using the constant cDevice. Each Cost within the Device structure is then input in turn.
 - λ(B) Device is incorrectly initialised using the constant cDevice. Each Cost within the Device structure is then input in turn.
 - ×(C) The data structure Device is replaced by cDevice. A subscript out of range error would occur when the code following Main is executed.
 - (D) Device is incorrectly initialised using the constant cDevice. The variable Cost is then repeatedly set to each Input.

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)

A freelance Web designer has developed a series of integrated Web pages for one of their clients. The pages utilise a system known as Active Server Pages (ASPs). This system uses a common scripting language to read and write to a database, it then creates the HTML pages based upon the information retrieved from the database. These HTML pages are then sent to the Internet users for viewing within their browser. It operates in a similar manner to many commercial On-line shopping sites but has some new methods of achieving the results.

- (a) The web site has a search facility. On the search page, the Internet user enters one or more words into a text box. This information is then sent back to the Web site where it is analysed. Due to the design of the database, the search words have to be placed into an ascending alphabetical order. DoSplit is intended to retrieve a string from an incoming web request, split this string into an array of strings, and then sort the array into ascending order.

The algorithm created to perform most of the DoSplit processing is reproduced below:

```

1. BEGIN DoSplit(SearchWords())
2.   AllWords = RetrieveText
3.   IF HasCharacters(AllWords) THEN
4.     SearchWords() = Split(AllWords, " ") 'Splits the text into a string array
5.     SortWords (SearchWords())
6.   END IF
7. END
8.
9. BEGIN SortWords(SearchWords())
10.  UnsortedAreaStart = 1
11.  WHILE UnsortedAreaStart < LastElementInArray(SearchWords())
12.    LaterString = SearchWords(UnsortedAreaStart)
13.    PositionOfLaterString = UnsortedAreaStart
14.    FOR Count = UnsortedAreaStart + 1 TO LastElementInArray(SearchWords())
15.      IF SearchWords(Count) > LaterString THEN
16.        LaterString = SearchWords(Count)
17.        PositionOfLaterString = Count
18.      END IF
19.    END FOR
20.    SwapStrings SearchWords(PositionOfLaterString), SearchWords(UnsortedAreaStart)
21.    UnsortedAreaStart = UnsortedAreaStart + 1
22.  ENDWHILE
23. END

```

Question 21 continues on the next page

- (i) Using the test data below, perform a desk check of the SortWords procedure.
Use a separate column for each array item.

3

SearchWords(0) = "apple"

SearchWords(1) = "zoo"

SearchWords(2) = "key"

SearchWords(3) = "monkey"

name

Variable	Value	Variable	Value	Variable	Value	Variable	Value
(0)	"apple"	(1)	"zoo"	(2)	"key"	(3)	"monkey"
	"apple"		"key"		"monkey"		"zoo"
(1)							

Question 21 continues on the next page

(ii) With reference to your desk check in part (i) describe any problems in the algorithm and suggest how these problems could be corrected.

3

1 - The problem is that it doesn't sort the values properly. These problems could be corrected by firstly drawing a new algorithm for the portion that doesn't work. This should be desk checked to make sure it works. The fix can then be implemented into the code. Changes should be clearly documented so that future programmers will not make the same mistake.

Vague

How

(iii) Identify the type of sort used in the SortWords algorithm.

2

Explain the logic used in this sort.

Selection Sort. The first element is marked and then the rest of the array is searched for the smallest value.

2 - When this is found, they are swapped. This is repeated as many times as there is elements in the array. Therefore, at the end of this process, the elements will be sorted in ascending order.

a, b
a = c
b = a
c = b

(iv) The intended scripting language for coding this algorithm does not have a SwapString function. Write a suitable algorithm for performing this task.

2

SearchWords(PositionOfLaterString) = temp
SearchWords(UnsortedAreaStart) = SearchWords(PositionOfLaterString)
temp = (UnsortedAreaStart)

a, b
p, v
a = c
b = a
c = b

s, 7
s = c
7 = a
5 = b

Question 21 continues on the next page

- (b) The Web designer has contracted a Web-hosting organisation, which has the facilities to run the scripts and related files, to host the Web site for the Web designer's client. The contract between the Web-hosting company and the Web designer is for supply of hosting services and is based on a cost per Megabyte transmitted or received basis.
- (i) Once the ASP code has been placed onto the hosting web server, who owns the code? What about the data that is (or will be) stored in the database on the hosting web site, who owns this data?

3

Discuss in relation to authorship and copyright laws.

3

In relation to copyright the person who undertakes the creative process owns the copyright. Therefore, the web designer has created the ASP scripts and therefore is the natural copyright owner. The data to be stored in the database will be owned by the client. The database management system is always owned by its creator but the database, which is created by the end user, is owned by the end user due to authorship of intellectual property.

- (ii) The reality is that most Web hosting companies have little control over the content of Web sites on their servers. Discuss ethical issues related to the Web designer using a Web-hosting organisation to host web sites for clients.

3

12

Web hosting companies do have little control over the pages on their servers. There would be hundreds of thousands of pages on the server and users may upload offensive material like pornography or bomb-making instructions. The ethical issues for the web-designer is that their pages may be hacked. The hacker could deface the homepage with pornography or racism. Customers would be turned off coming ever again to the web page and this would result in lost revenue for the website and a tarnished company image.

Question 21 continues on the next page

little
said

- (iii) The code in the Active Server Pages (ASPs) is in text form and can therefore easily be read by someone who has internal network access to the Web server. The site has been tested for external security holes and is certified secure from all forms of hacker attack.

4

Discuss the responsibilities of the management of this host site to ensure that the code in the pages is kept secure. In your answer outline some strategies that could be used to implement and maintain these responsibilities.

The management of the hosting company must clearly tell the employees of their rules. When employees are informed of the company rules and the consequences of breaking them, they are unlikely to break the rules. Also, the company should check all employees leaving the office to make sure they are not stealing the ASP scripts on removable media. Employees could steal the ASPs on floppy disks.

The company should also have a fire wall so that all incoming and outgoing data is checked.

The firewall computer could check employee's outgoing emails against a database of ASP scripts. It would compare emails to the database and stop any emails containing the ASP scripts. It could also send a message to the boss telling him/her who the employee was.

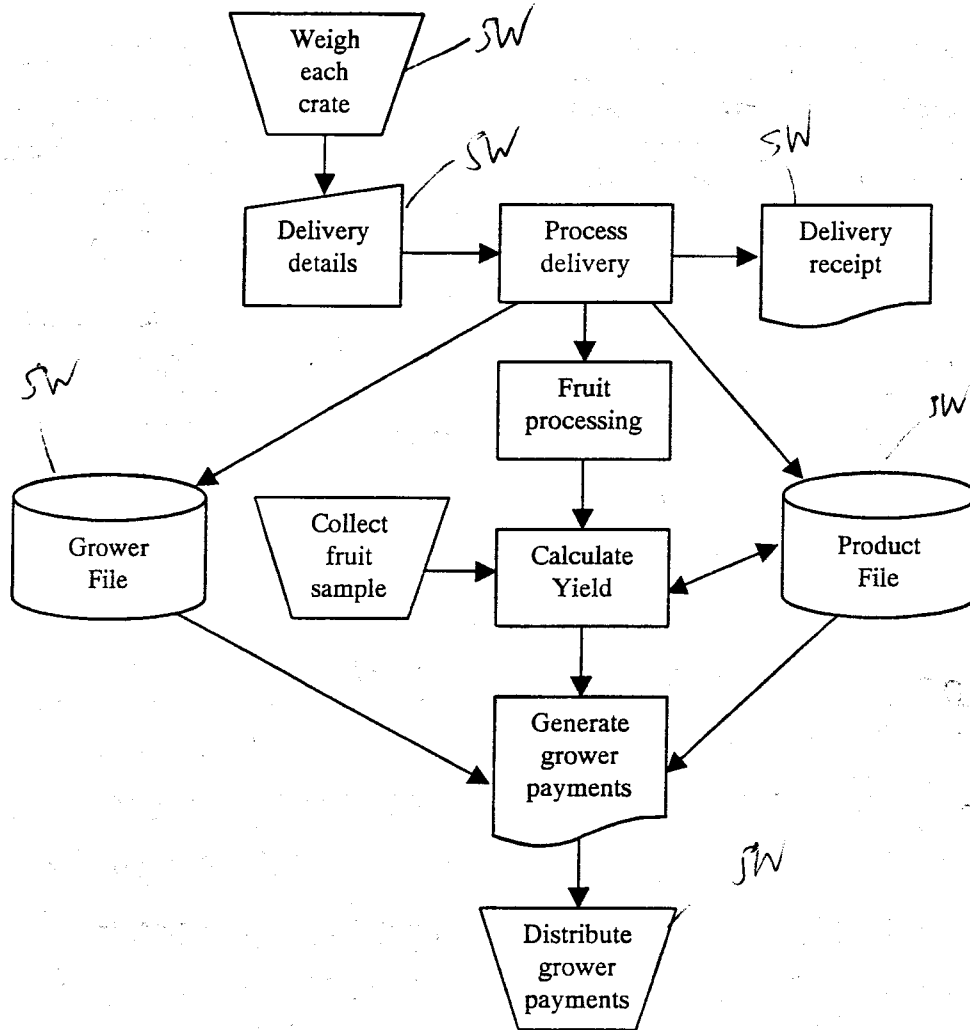
The last strategy is good communication between employees and management. There should be regular scheduled meetings for the employees to openly discuss their feelings with management. Employees who are happy and feel their company values them highly are less likely to steal to make some extra money or try to get back at their company for mistreating them.

End of Question 21

Question 22. (20 marks)

A fruit processing plant is examining the feasibility of having a new software system developed to automate suitable parts of the administration of its operation. A software development company has been contracted by the plant to examine the existing manual system and recommend the most suitable solution.

A systems analyst from the software development company is currently collecting information on which the recommendations will be based. The system flowchart below has been created by the analyst to model the essential logic and flow of data through this system for an individual grower's fruit.



The grower file would be used to hold details on each individual grower. These details include their name, address, phone number and ABN. The products file is to contain information about each fruit delivery as it moves through the processing plant. The details within the product file include, amongst other things, the type of fruit, a maturity index (which is a number in the range 0.00 to 7.00 indicating the ripeness of the fruit product), delivered weight and also the yield. The yield is the amount of product derived after processing divided by the original delivered weight, and is expressed as a percentage. The amount of product derived is calculated using random samples of fruit from each grower. Reliability of yield is vital as growers are paid for fruit at a rate based on the yield.

Question 22 continues on the next page

- (a) Discuss aspects of this system that are suitable for inclusion in the software and aspects that are more suitable to remain as manual operations.

The first process of weighing the crate could be done using a weighing station. The box could roll over the weight station and a fixed barcode reader could read each box's details as it passes by. The 'Process Delivery' could also be done by software as data from the barcode and weight sensors could automatically added to a database by special software. Delivery receipts could be set to automatically print out as the data is recorded to the database. The distribution of the grower payments could also be done by software and a communications link. The fruit company could use the computer system to automatically pay the grower using EFTPOS. This way, the money would automatically appear in the grower's account without the need for manual processing of bank statements. One thing that does need to remain as a manual operation is the entry of data into the product file. A computer sensor cannot detect such things as what the maturity of the fruit is. This needs a subjective judgement of the human eye. The yield also needs to be kept manual. A computer system cannot pick random samples of fruit and assess them. This needs to be done by a human. Apart from these two processes which must use human judgement the earlier stated processes of accepting crates, weighing them, and finding out what grower they are from, can be done with software.

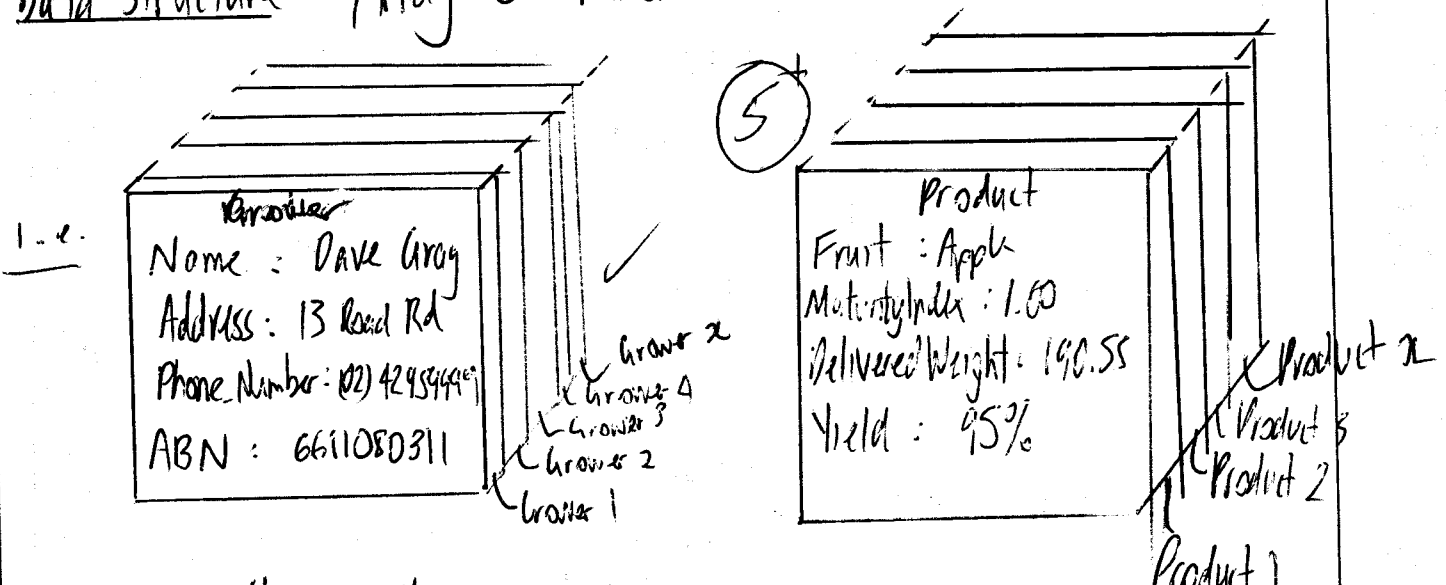
Question 22 continues on the next page

- (b) Create a data dictionary for both the Grower and Product files. Describe the data structures used to hold this information during processing using diagrams or specific examples to illustrate your answer.

6

<u>Grower</u>			
Name	Type	Validation	Example
Name	Text	Up to 50 characters	David Waterworth
Address	Text	Up to 50 characters	27 Sydney Road, Kattern
Phone Number	Text	Up to 13 characters	(02) 4229 7777
ABN	Integer	10 digits only	5837211059
<u>Product</u>			
Name	Type	Validation	Example
Fruit	Text	Up to 20 characters	Cauliflower
Maturity Index	Real	$0 \leq \text{Maturity Index} < 7.00$	3.70
Delivered Weight	Real	Up to 5 digits	120.50
Yield	Percentage	$0 \leq \text{Percentage} \leq 100$	80 %

Data Structure : Array of Records



Each "plate" is an record, the collection of them an 'array of records'!

Question 22 continues on the next page

(d) A number of the employees at the fruit processing plant are concerned about the impact of the new software on the nature of their jobs and work routines. As a consequence the plant's management have asked for a practical demonstration to be given in an attempt to promote understanding and acceptance by the workers.

You have been assigned the task of creating a prototype detailing the main input screens. This prototype will be used during the practical demonstration.

In the space below, construct a storyboard and a series of screen designs that will form the basis of the prototype. Identify important features on your designs.

Screen 1: Main Menu
 Fruit Company NSW
 MAINTENANCE | PROCESSING
 Add/Remove Grower | Process Delivery
 Add/Remove Product
 Welcome To The Main Screen

Screen 2: GROWERS
 Fruit Company NSW
 ADD | REMOVE
 Name: [] Grower ID: []
 Address: []
 Phone: []
 ARN: []
 (ADD) (REMOVE)
 Add or remove growers

Screen 3: PRODUCTS
 FRUIT COMPANY NSW
 PRODUCTS
 ADD | REMOVE
 Name: [] Product ID: []
 Manufacturing: []
 Delivery Weight: []
 Yield: []
 (ADD) (REMOVE)
 Add or remove product

Annotations:
 - Company Logo Identifies product
 - Headings are clear / unambiguous
 - Consistent design elements
 - Instruction Bar Told User Where They Are
 - Separates different parts of program. Improves useability.
 - Divides the text
 - Similar headings to other screens
 - Logo
 - Data Entry Fields
 - Same logo as all other screens
 - Same buttons as all other screens
 - Same instruction area as all other screens
 - All similar design elements insure user becomes comfortable quickly
 - Very similar, ensures comfort to the user
 - Breaks the text into logical areas

(56)

Question 23. (20 marks)

Acme Accounting Company has over 10,000 customer accounts, details of which are stored in a sequential file on disk. Each record contains the following details:

- Customer account number
- Password
- Current balance

Each morning, the customer details are read in from disk, and stored in an array of records. The last record in the file contains a sentinel value of 99999 as the customer account number.

Throughout the day, customers can deposit or withdraw funds, and new customers can join up with the company. When this happens, they are allocated the next sequential customer account number in sequence, and a new password is generated for them as specified below.

Once validly generated, the new customer account number and valid password are to be stored at the next vacant position in the array of records, with the current balance equal to the opening balance specified by the joining customer.

At the end of the day, all of the customer details stored in the array of records are to be written back to disk.

The mainline for the program is given in the following pseudocode.

```
BEGIN AccountProcess
  OPEN Accounts File for Input
  LoadCustArray
  REPEAT
    Ask for next_transaction
    CASEWHERE next_transaction
      1: Withdrawal
      2: Deposit
      3: NewCustomer
    ENDCASE
  UNTIL next_transaction = 4
  EndOfDay
END AccountProcess
```

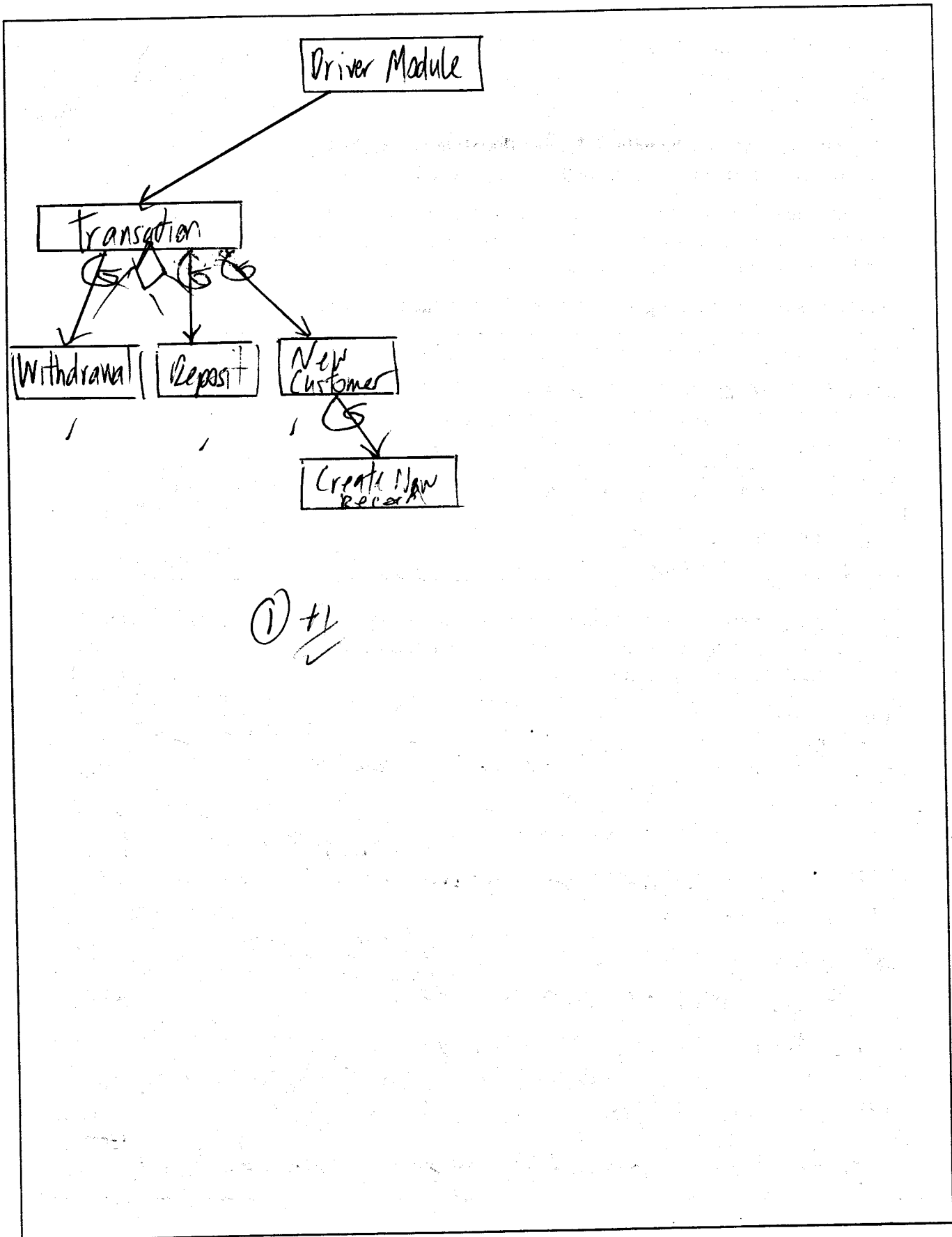
The NewCustomer routine has the following logic:

```
BEGIN NewCustomer
  Ask for Customer_Details
  AllocateNextAccountNo
  REPEAT
    GeneratePassword (pword)
    CheckIfUnique(pword, error_flag)
  UNTIL error_flag = 0
  CreateNewRecord
END NewCustomer
```

Question 23 continues on the next page

- (a) Construct a structure diagram to represent this system as it is described in the two algorithms above.

4



Question 23 continues on the next page

- (b) The password is an 8-character sequence, generated by taking 7 random letters, alternately in upper and lower case. A digit between 1 and 9 is to be placed into a random position within the password.

Following are examples of valid passwords:

RsIc7RuP
5KjDdSwK
Fy4MyFqT

8

A password must also be unique. It must therefore be checked against all current passwords to ensure it is unique before it is accepted.

Using either flowcharts or pseudocode, design algorithms for the GeneratePassword and CheckIfUnique routines using the appropriate parameters, and assuming that the array of records is defined as Global.

(Further space for your algorithms is provided on the next page)

```

BEGIN GeneratePassword
password is a Record where
letter is an array of characters indexed from 1 to 7
digit is an integer
index = 1
password[index] is a password Record
FOR letter = 1 to 7
randomize letter ✓
END FOR
randomize digit
Print 'would you like to generate another password?' yes/no
read input
Check?
also call UNTIL input = yes
END
REPEAT
/6.

BEGIN CheckIfUnique c 'generated'
read userpass
FOR index goes from 1 to last index of array
IF userpass = password[index] THEN
found = true
END IF
END FOR
IF found = true THEN
print "Sorry, password already exists." no...
PTD
    
```

Question 23 continues on the next page

(Further space provided for answering part (b))

```

ELSE
  Generate Password ✓
END.

```

- (c) You have been directed by your project manager to test the CheckIfUnique routine, once it is coded, using a driver. Design an appropriate algorithm for the driver, and explain how it could be used to test the CheckIfUnique routine.

4

```

BEGIN DriverModule (pw), (u)
  get password from user
  FOR index goes from 1 to last of userpasswords
    IF userpasswords[index] = password THEN
      unique = false
    END IF
  END FOR
END

```

(3)

This driver module could be checked by appropriate test data, that is, both valid passwords and invalid passwords. The outputs of the driver module could then be checked against expected outputs.

Question 23 continues on the next page

- (d) The ACME Accounting Company's custom application is being developed by a team of developers. Critically evaluate different types of software debugging tools suitable for use during the products development.

4

One debugging tool is the single line stepping. When one of the ACME programmers has isolated an error to a small section of the program, they could execute the program line by line and see what line the error is caused. Another software tool is tracing. The ACME software developers could have a trace window open to see how the values of variables are changing. Another software debugging tool is the use of breakpoints. The ACME software developers could halt execution at certain points in their program until they are happy the program is working up until the break in execution. The ACME developers would use this technique when they still haven't located the error in a small portion of the program. Another technique the ACME software developers could use is setting variables back to known contents. This technique is useful when values from an external file were supposed to have been read into the program. If the ACME programmers set the values back to ones they know the outputs for and the program then works they would know their reading the passwords in module is faulty.

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)

- (a) A new program is being written to manage the functioning of the school library. The code below is a fragment of this program.

```
class Item
{
public:
void virtual create ();
void virtual get_details ();
void borrow (int customer_id, int no_copies);
void return (int customer_id, int no_copies);
private:
char() * isbn;
char() * publisher;
char() * title;
int total_copies;
int copies_borrowed;
}
class Book : public Item
{
public
void virtual create ();
void virtual get_details ();
private
char() * author;
}
class Magazine : public Item
{
public
void virtual create ();
void virtual get_details ();
private
int issue_no;
}
```

- (i) The library has an extensive collection of video movies. Make the necessary additions to the code to include videos in the program. 2
- (ii) Identify the programming paradigm demonstrated by the code fragment above. Describe each of the characteristics of the paradigm evident in this code. 5
- (iii) Explain how the development of the paradigm demonstrated in the code above has affected the productivity of the programmers who use it. 4

Question 24 continues on the next page

(b) Consider the following problem:

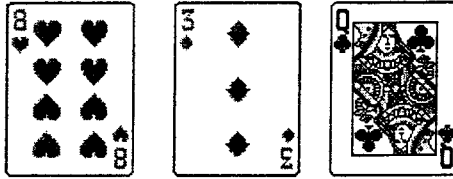
5

There are three playing cards face-up on the table.

- A heart is on the left of a club
- A queen is on the right of a three
- An eight is on the left of a diamond
- A diamond is on the left of a club

From left to right, what are the three playing cards?

This is a bit of an odd examination question as the solution is reproduced below:



Describe how this solution can be found (or confirmed) using firstly a backwards-chaining strategy and secondly using a forward-chaining strategy.

(c) The logic paradigm is based on facts and rules, the functional paradigm is based on functions, and programming languages based on either of these paradigms are collectively called declarative languages.

4

Contrast declarative programming languages with more commonly used imperative programming languages.

End of Question 24

Question 25 – Software Developer’s View of the Hardware (20 marks)

(a) The following is a small portion of a text file viewed in hexadecimal.

54 68 69 73 20 66 69 6C
65 0D 0A 63 6F 6E 74 61
~~69 6E 73 0A 74 65 78 74~~

3

Using these hexadecimal to ASCII code equivalents as a guide:

- 0A – control character: LF
- 0D – control character: CR
- 20 – ASCII: space
- 41 – ASCII: A
- 61 – ASCII: a

Write out the above hexadecimal code as text as it would appear on a print out.

(b) A simple computer uses a 4-bit twos complement binary system for representing and manipulating integers. This system cannot perform the following calculation correctly.

4

$$-7 - 4 = -11$$

By showing all working, in binary, explain why the computer cannot correctly perform the subtraction and state what would occur as a result.

(c) To represent fractional and very large numbers many computer systems use the IEEE 754 single precision floating point standard. This standard specifies the use of 32 bits, where:

- the first bit represents the sign of the number
- the next 8 bits represent the exponent plus 127
- the remaining 23 bits represent the mantissa with the leading 1 removed

(i) Using the above information convert the following IEEE 754 single precision floating point number into its decimal equivalent.

2

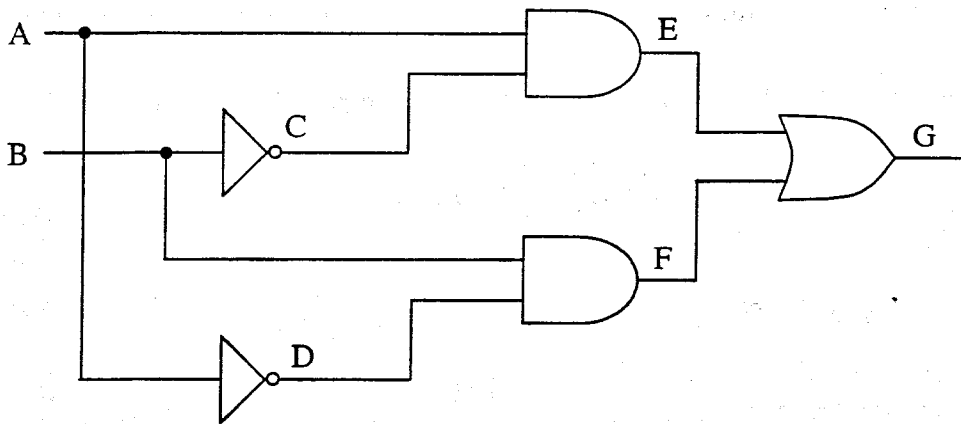
0 10000010 100001000000000000000000

(ii) Distinguish between floating point and fixed point as methods for storing a real number in a computer system. Why is floating point used so extensively?

2

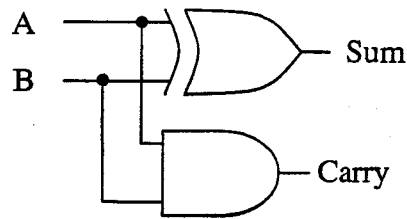
Question 25 continues on the next page

(d) Consider the following circuit diagram.



- (i) Complete a truth table for the above circuit showing all possible combinations of inputs at A and B, the intermediate values at C to F and the final outputs at G. 2
- (ii) Construct a simpler circuit diagram than the one above that produces the identical set of outputs. 2

(e) The circuit diagram below is a binary half-adder.



- (i) Using the half-adder above, draw a circuit diagram for a full adder. 3
- (ii) Most computers use either 32 bits or 64 bits to represent integers. Describe how full adders can be connected to perform addition with these numbers. 2

End of paper