Number: _____

James Ruse Agricultural High School

2014

HIGHER SCHOOL CERTIFICATE TRIAL HSC EXAMINATION

Software Design and Development

General Instructions
- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil

- Answer All the questions in the Answer booklet with each question clearly marked

Number: _____

Total marks – 100

Section I Pages 1-8

20 marks
• Attempt Questions 1–20
• Allow about 25 minutes for this section

Section II Pages 9-15

50 marks
• Attempt Questions 21-24
• Allow about 100 minutes for this section

Section III Pages 16-18

30 marks
• Attempt Question 25
• Allow about 55 minutes for this section

Number: _____

Section One: Multiple Choice (20 Marks)

1. Beta testing can be best described as
   (A) Testing of the final solution by personnel within the software development company
   (B) Testing of the final solution by the end users of the released solution.
   (C) Testing of the inputs and outputs by the software developers
   (D) Testing of the final solution by a limited number of users that are external to the software developers.

2. A rough drawing or drawings that model the look and possible connections of a proposed application's user interface is called
   (A) a storyboard
   (B) a data flow diagram
   (C) a structure diagram
   (D) an IPO chart

3. The major purpose of source code documentation is:
   (A) To provide a means for programmers to creatively influence the source code
   (B) To enable future maintainers to more easily understand the source code
   (C) To provide an audit trail. In this way the programmer responsible for a bug can be identified
   (D) To allow users to better understand the processing taking place in the application.

4. Production of printed documentation is becoming less common. Which of the following reasons is the most important?
   (A) The cost of printing is too high
   (B) Users rarely read printed manuals
   (C) People prefer electronic forms of documentation
   (D) Electronic forms are far easier to edit and distribute

5. CASE tools used during the testing evaluation stage:
   (A) are used to automate tedious and repetitious tasks
   (B) provide a means of producing system models
   (C) assist developers in the construction of code
   (D) ensure design specifications remain consistent across the application

6. The difference between live test data designed to test large file sizes and that designed to test volume data is :
   (A) large file sizes test the ability of the software to retrieve data; volume data tests the ability of the software to process large amounts of input simultaneously
   (B) large files ensure the product is robust in design; volume data ensures logic errors are identified
   (C) large file sizes test the ability of the software to process data correctly; volume data tests the ability of the software to process large amounts of data
   (D) large file sizes can cause arithmetic overflow errors which must be identified; volume data is used to test the user interface

Use the following to answer Questions 7 and 8.

Character is an empty array used to store letters in the range A to Z.

```
MyCharacter = 'A'
FOR index = 1 to 20
    Input character[index]
    IF MyCharacter < character[index] THEN
        MyCharacter = character[index]
    END IF
NEXT index
Output MyCharacter
```

7 What does this pseudocode segment do?

(A) It performs a binary search on the array.

(B) It sorts data as it is entered into the array.

(C) It enters characters into the array and identifies the largest letter.

(D) It performs a standard linear search of the filled array to find the largest letter.

8 What are the control structures in this pseudocode segment?

(A) Post-test loop and binary selection

(B) Counted loop and binary selection

(C) Post-test loop and multi-way selection

(D) Counted loop and multi-way selection

9 A software developer uses specific software to assist in the management of versions during the development process.

What is the common name of such software?

(A) Security management tools

(B) Structured development packages

(C) Debugging development packages

(D) Computer aided software engineering tools

10. A large DVD collection is ordered according to the release date. To find a particular movie title, what is the most efficient search method to use?

(A) Binary
(B) Insertion
(C) Linear
(D) selection

< The rest of this page is blank>

11 Consider the following algorithm.

```
BEGIN
    READ first_number, second_number
    REPEAT
        total = first_number + second_number
        first_number = second_number
        second_number = total
    UNTIL total > 8
    PRINT second_number
END
```

If first_number = 1 and second_number = 2, what is the first value of second_number printed by the program?

(A) 5

(B) 8

(C) 13

(D) 21

12 Consider the following piece of code.

```
SUBROUTINE Calc_Comms (emp_id, emp_hrs)
    PRINT "sub calc_comms commenced"
END SUBROUTINE
```

What is this an example of?

(A) A flag

(B) A stub

(C) Run-time checking

(D) Variable identification

13 Which of the following is a major problem with prototyping?

(A) Provision of feedback from users is simple.

(B) Development time is increased unnecessarily.

(C) The users of the system have a direct involvement in the development of the prototype.

(D) The project team may be committed to a solution before there is a thorough understanding of the problem.

Use the folloing information to answer Question 14 and 15.

```
BEGIN PrintPeople (People)
        FOR i= 1 To the number of people
            PRINT People(i).FirstName + “” + People(i).LastName
        NEXT i
END
```

14. What is the control structure used in the algorithm?

(A) Pre-test loop
(B) Counted loop
(C) Post-test loop
(D) Multiway loop

15. What type of data structure is used for the People variable?

(A) A record
(B) A sequential file
(C) An array of records
(D) A two-dimensional array

16

Consider the following code, where variables a, b and c each store different integer values.

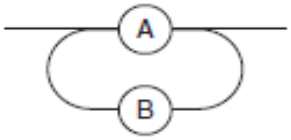
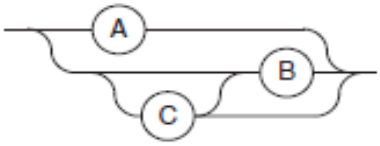
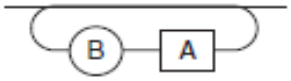
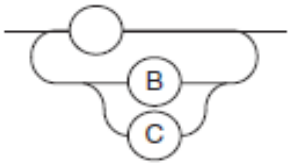
```
IF a > b THEN
    IF b > c THEN
        PRINT c
    ELSE
        PRINT b
    ENDIF
ELSE
    IF a > c THEN
        PRINT c
    ELSE
        PRINT a
    ENDIF
ENDIF
```

What will this code print?

(A) The numbers in ascending order
(B) The numbers in descending order
(C) Only the largest of the three values
(D) Only the smallest of the three values

17.

Which of the following correctly matches an EBNF statement with its railroad diagram?

(A)	A {A B}	
(B)	A | B | C [B]	
(C)	{A < B >}	
(D)	A [{B} | {C}]	

18. Which of the following best describes *acceptance testing*?

(A) Testing that the system can accept large volumes of data
(B) Testing the user-friendliness of the interface by the end users
(C) Testing whether the response times are acceptable to the end users
(D) Testing whether the system is ready to become available to the end users

Number: _____

Use the following algorithm to answer Questions 19 and 20.

```
10      BEGIN
20          GET target
30          index = 1
40          WHILE index < = lengthOfArray (dataArray)
50                  IF dataArray [index] = target THEN
60                      PRINT "Target value found"
70                  ENDIF
80                  index = index + 1
90          ENDWHILE
100     END
```

19 What type of search algorithm is this?

(A) Binary

(B) Bubble

(C) Linear

(D) Random

20 A new line is to be inserted between lines 60 and 70 to improve the algorithm when searching for a target in an array of unique values.

Which of the following best does this?

(A) found = TRUE

(B) target = index

(C) PRINT "Target NOT found"

(D) index = lengthOfArray (dataArray)

Number: _____

Section II Total: 50 marks

Question 21 **(13 marks)**

(a)

A CPU's instruction set contains the following instructions:

LOAD (R*n*, M*x*)	Load register R*n* with the content of memory location M*x*
STORE (R*n*, M*x*)	Store the content of register R*n* in the memory location M*x*
ADD (R*s*, R*m*, R*n*)	Add contents of registers R*m* and R*n* and store the result in register R*s*
STOP	STOP execution

Registers R1 to R8 and memory locations M1 to M16 are available.

(i) Describe the role of registers in CPU operations. (2)

(ii) Explain the use of program counter in the fetch-execute cycle. (1)

(iii) Using the instruction formats given, write a set of code to show how the CPU adds the content of memory locations M1 to the content of memory location M2.(3)

(b)

Distinguish between program level and system level testing. (3)

(c)

Smart High School is developing a reporting system that will import details of subjects, classes, teachers and students from text files generated from the existing administration system. A report layout will be created using the imported data for teachers to enter marks and comments. Reports will be checked to make sure that they are all complete before printing takes place.

Construct a structure diagram to represent the reporting system. (4)

End of Question 21

Number: _____

Question 22: **(10 marks)**

An astronomer maintains information on planets and stars in a data structure called SpaceItems, part of which is illustrated in the table below. The structure currently holds data on 2200 stars and planets.

Index	ID	Name	Type	Brightness (1)	Brightness (2)	Brightness (3)	•••
1	Alpha3	Romulus	Planet	3.44	3.56	4.01	•••
2	Sol0	Sun	Star	100.00	100.00	100.00	•••
3	Sol1	Mercury	Planet	2.34	2.34	1.98	•••
•••	•••	•••	•••	•••	•••	•••	•••

In the SpaceItems structure the Brightness field provides a second dimension to the data and records the brightness as measured on the first day of each month. Brightness is indexed from 1 to 500. The brightness value defaults to 0 if no value is entered.

(i) Identify the type of data structure illustrated above (2)

(ii) Write an algorithm which will enable the user to enter a required planet's or star's Name, perform a search for every occurrence of the required name and display the found entries using Name and Type. If nothing is found then it should report "Not found". (4)

(iii) Write an algorithm which will display the ID of each item (Planet or Star) and the highest Brightness recorded for that item. (4)

Hint: To refer to Mercury in Index three, you can use SpaceItems(3).Name
Therefore the right syntax for this is SpaceItems(Counter).Name

End of Question 22

Question 23: **(7 marks)**

A small veterinary practice has contracted an analyst-programmer to develop a software solution for the management of its client files. Currently the practice has no software system.

The proposed system will perform the following functions:

- Inputting, viewing and storage of contact details and consultation history
- Printing of receipt on the completion of a consultation
- Producing reports

Three files, a client master file, a pet file and a consultation history file are used to store the details.

The client master file contains the following:

- Client ID (unique identification for each client, cannot be null)
- Salutation (must be Mr, Mrs, Ms, Miss, Dr or Professor)
- Last name of client
- First name of client
- Phone number (cannot be dull e.g. 02-9876 5432)
- Street address (e.g. 99 Good View Parade)
- Suburb
- State (default to NSW, must be NSW or VIC)
- Postcode
- Date last visit (in ddmmyy format e.g. 010506)

(a) Construct a data dictionary to describe the contents of the client master file. **(4)**

(b) Explain how the data dictionary will be useful for the programmer. **(3)**

End of Question 23

Question 24: (20 Marks)

(a) A large array of Products [ ] records have to be sorted by their ID field. The following algorithm has been proposed to achieve the sort.

Note: The Products [ ] array of records is a global array that is defined elsewhere in the program and may contain over 10,000 elements.

```
BEGIN SortProducts

        FOR CurrentPos = (StartOfProducts +1) TO EndOfProducts
        NewPos = FindPosition (CurrentPos)
        MoveProductRecordInArray (CurrentPos, NewPos)

        ENDFOR
END (SortProducts)


BEGIN FindPosition (CurrentPos)

    LeftPos = StartOfProducts
    RighPos = CurrentPos

        WHILE LeftPos<RightPos
            MidPos = (LeftPos + RightPos) / 2
            IF Products[MidPos].ID <= Products[CurrentPos].ID
THEN
                LeftPos = MidPos +1
            ELSE
                RightPos = MidPos
            ENDIF

        ENDWHILE

        RETURN LeftPos

END (FindPosition)
```

(i) The function FindPositionis designed to find an appropriate position within the sorted section of the Products [] array to insert a record.

Identify and describe the searching logic that is used in this algorithm and compare it to the "Linear Search" logic. (Include the variables given in the algorithm in your answer.) (3)

(ii) The sub-procedure SortProducts uses "Insertion Sort" logic to perform the sorting of the large array. Using the following test data (array), demonstrate how an insertion sort is achieved in this sub-procedure. (2)

659	68	101	3098	3	752	2098

(iii) Write a suitable algorithm that can be used for MoveProductRecordInArray. The function of this sub-procedure is to move the Products record located at CurrentPos and insert it into the array at NewPos. (5)

Note: the value of NewPos will be less than CurrentPos and the Products array may contain over 10,000 records.

(iv) Explain why the programmer used separate sub-procedures for FindPosition and MoveProductRecordInArray instead of placing all of the code inside the SortProductsProcedure. (2)

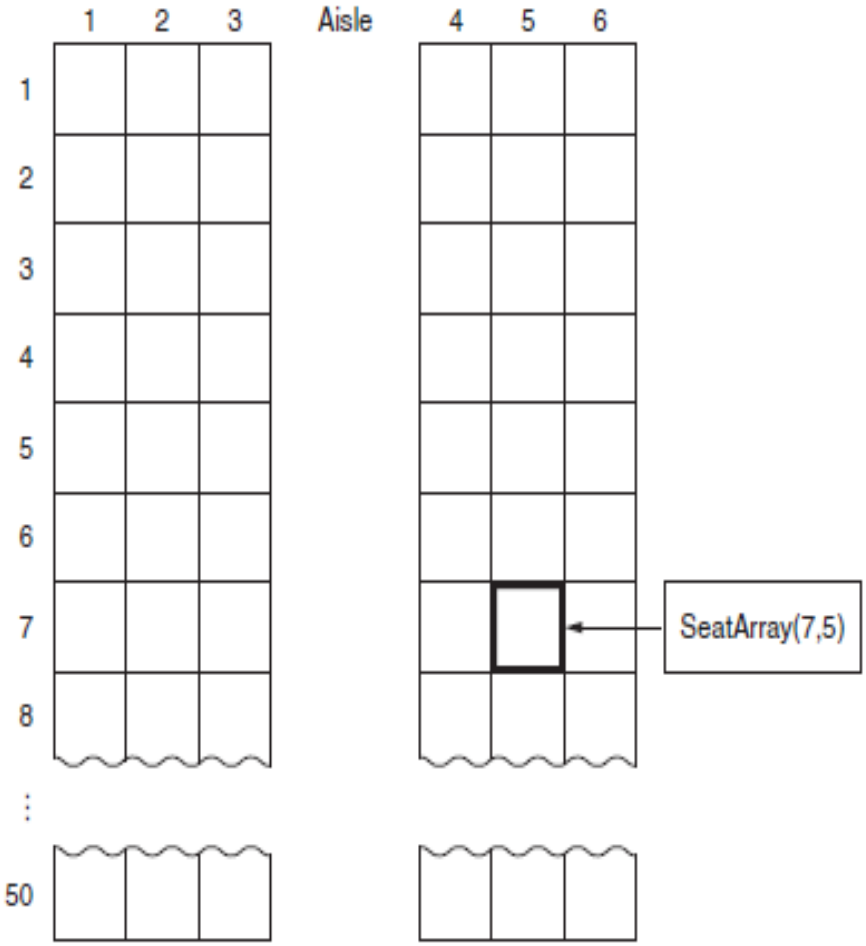
Question 24 continues on next page

(b)

Number: _____

A software company is developing a computer-based check-in system for an airline. The system includes a module which handles seat allocations for passengers.

The airline only operates one type of aircraft. The cabin of this aircraft has fifty rows with three seats on either side of the aircraft separated by an aisle. In total there are 300 seats in the cabin.



The seating configuration is represented by a two-dimensional array named SeatArray. As an example the seat highlighted in the diagram would be accessed as SeatArray(7,5). Each element of the array contains the unique ticket number of the passenger occupying that seat. A 0 value indicates the seat is vacant (unallocated).

It is important that the number of passengers on each side of the plane is balanced.

Develop an algorithm that will count the number of passengers allocated on each side of the plane and return either 'left side too many', 'balanced' or 'right side too many.' (4)

(C)

Pike Pathology provides patients with medical strips to conduct blood tests at home. These medical strips can be inserted into smart phones using special attachments.

The smart phone has an app that:

- processes data captured from the medical strips
- records the blood test data on the patient's phone
- transmits this data to Pike Pathology.

Software on Pike Pathology's computer system will:

- analyse the data and store the result in the database
- alert the patient if a blood test has not been done
- alert the patient's doctor if the results of a test are abnormal
- allow the patient's doctor to access Pike's database to retrieve results.

The doctor then communicates with the patient, if necessary.

Draw a data flow diagram of this system (4)

End of Question 24

Section III 30 Marks

Question 25

(a) Objects in the object oriented programming paradigm include attributes and methods.

(i) Define the term "method" and provide example (2)
(ii) All objects hide the internal detail of their methods and attributes. Explain how this feature assists programmers. (3)

(b) Identify TWO limitations of the imperative paradigm, and describe how each is addressed by either the object oriented paradigm or the logic paradigm. (3)

(c) A museum has a database which identifies dinosaurs based on their features. The software associated with the database was developed using the imperative paradigm.

The following is part of the information in the database. Name of dinosaur	Period lived	Number of legs	Diet type
Allosaurus	Jurassic	Two	Carnivore
Diplodocus	Jurassic	Four	Herbivore
Triceratops	Cretaceous	Four	Herbivore
Tyrannosaurus	Cretaceous	Two	Carnivore

The following fragment of code was part of the software.

```
IF X had two legs THEN

    X could run

ENDIF


IF X was a dinosaur AND X was a carnivore THEN
    IF X and Y lived in the same period THEN
        X could eat Y
    ENDIF
```

ENDIF

The database software will be rewritten using the logic paradigm.

(i) Describe the role of the inference engine in this new software (3)

(ii) Write code for TWO facts and TWO rules for the new software based on the information provided. (4)

(d) Define

- Inheritance
- Encapsulation
- Polymorphism

In relation to the object-oriented programming paradigm and explain how they improve productivity. (6)

(e) Consider the following segment of code which has been written using the Object Oriented Programming (OOP) paradigm.

```
class PERSON {

private – id_no: integer

          firstname: string

          surname: string

          dob: date

          gender: character

public – getFullName(id_no):

                return firstname & surname

}

sub–class STUDENT {

is a PERSON

private – year_group: integer

public – getYearGroup (id_no):

                return year_group

}
```

Number: _____

(i) Identify a method in the code. (1)

(ii) Based on the code, define a subclass TEACHER of PERSON which has three attributes with its data types. (You will need to include three attributes for Teacher and its data types with the correct Structure in your answer.) (3)

(f) Your teacher, Ms Chen is trying to classify various types of kid's toys for her son Ryan and the information will be useful for other new mothers she knows. Ms Chen has categorised the toys to determine the suitability of different toys for different age group children. For example, toys with very soft material and bigger than 10cm in length and 5 cm in width is in the infant toy category (to prevent the toy to be swallowed by the infants). Some of the the features Ms Chen uses may include colour, weight, size, material and texture.

Ms Chen would like Ryan to carry out the classifications process and she requires a system to be developed which accepts the necessary information about the toy and classifies it.

Recommend the most appropriate paradigm for the solution of this problem. Explain why the other paradigms you have studied would be less appropriate. (3)

(g) Discuss the meaning of the terms backward and forward chaining in Logic Paradigm. (2)

End of Exam

Answer:

Part A:

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

Number: _____

D	A	B	D	A	A	C	B	D	C	C	B	D	B	C	D	B	D	C	D

Q21: 13marks in total
(a)
(i) 2marks

A register is a special high-speed storage area within the CPU. Manipulating data using registers within the CPU is
much faster than accessing RAM directly. All data must be represented in a register before it can be processed. For example, if two numbers are to be multiplied, both numbers must be in registers, and the result is also placed in a register. The register can contain the address of a memory location where data is stored rather than the actual data itself.
(The number of registers that a CPU has and the size of each (number of bits) help determine the power and speed of a CPU. For example a 32-bit CPU is one in which each register is 32 bits wide. Therefore, each CPU instruction can manipulate 32 bits of data.)

(ii) 1 mark\

The program counter is a register within the CPU. It stores the memory location of the next instruction to be processed by the CPU. At the 'fetch' stage, the memory location in the program counter is used to locate the next instruction from main memory and the program counter is then updated to point to the next instruction.

(iii) 3marks

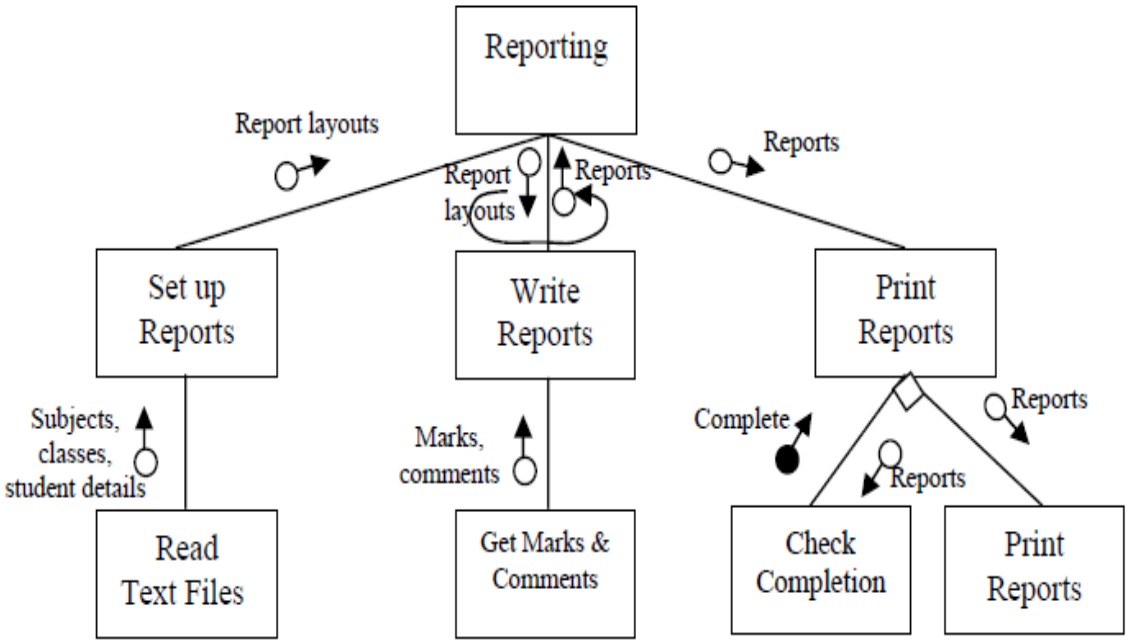
LOAD (R1, M1)
LOAD (R2, M2)
ADD (R3, R1, R2)
STORE (R3, M2)
STOP

(b) 3 marks

Program level testing involves connecting modules of code to the main program and testing that the modules and the program continue to function as required. System level testing aims to ensure that hardware, software, data, personnel and procedures that form the components of the final system work together correctly and efficiently. The emphasis of program level testing is on the integration of the modules to form a correctly working program while the emphasis of system testing is on the relationship and performance of the software with other components of the system.

(c) 4 marks

Sample Answer:



Question 22: 10 marks in total

(i) 2 marks

An array of records. Each record also contain an array of (decimal/real/float) numbers (for brightness)
OR
Multidimensional array of records.

(ii) 4 marks

```
BEGIN FindName
        Set Found to False
        Get RequiredName
        FOR counter = 1 to 2200
                If SpaceItems(Counter).Name= RequiredName THEN
                        Display SpaceItems(Counter).Name, and SpaceItems(Counter).Type
                        Set Found to True
                EndIf
        NEXT Counter
        IF Found = False THEN
                Display "Not Found"
        ENDIF
END
```

(iii) 4 marks

```
BEGIN FindBrightest
        FOR Counter =1 to 2200
                Set MaxBright to 0
                FOR BrightnessIndex = 1 to 500
                        IF SpaceItems(Counter).Brightness(BrightnessIndex) >
                        MaxBright

                        THEN
                        MaxBright =
SpaceItems(Counter).Brightness(BrightnessIndex)
                        ENDIF
                NEXT BrightnessIndex
        Display SpaceItems(Counter).ID
        Display “Maximum brightness recorded:”, MaxBright
        NEXT Counter
END
```

Question 23 (7marks in total)

(a) 4marks

Outcomes assessed: H5.2

Criteria	Marks
• A data dictionary with all columns complete and correct. Data validation criteria must be specified.	4
• A data dictionary with most of the columns complete and correct.	3
• At least 2 correct columns.	2
• At least 2 correct entries.	1

Answer could include:

Data Name	Data Type	Size	Description	Example
Client ID	Text	6	Unique identification for each client, cannot be null	ABC001
Salutation	Text	9	Must be Mr, Mrs, Ms, Miss, Dr or Professor	Mr
Last name	Text	20	Last name of client	Black
First name	Text	20	First name of client	Tim
Phone number	Text	12	Phone number (cannot be dull)	02-9876 5432
Street address	Text	30	Street address	99 Good View Parade
Suburb	Text	15	Suburb	Blacktown
State	Text	3	State (default to NSW, must be NSW or VIC)	VIC
Postcode	Text	4	Postcode	3172
Date last visit	text	6	Date last visit (in ddmmyy format)	010506

(b) 3 marks

Outcomes assessed: H5.2

Criteria	Marks
• Explains at least two uses	3
• Outlines at least two uses	2
• Outlines at least one use	1

Answer could include:

- Specifies the variables required
- Specifies rules of data validation
- Specifies formats and sizes of variables
- Provides better understanding of the requirements of the problem

Question 24 (20marks)
(a) (i) 3 marks

The search algorithm logic is a Binary Search. It works by finding the midpoint in the sorted section of the array, makes a comparison to see if the value matches the search value. If not found it redetermines a new left or right boundary of the search are, then determines the next midpoint and continues the search. The search terminates when there is only one element left to search in the search boundary.

Note: it does not terminate the search immediately after finding the value. It terminates when the left boundary (LeftPos) is the same as the right boundary (RightPos) of the search area. In an array of 10,000 elements it should not take more than 14 attempts to find an appropriate position (match or no match)

In contrast, the Linear Search logic dictates that the comparison starts at the beginning of the array (it does not have to be sorted), performs the comparison and moves to the next element if not found, continuing until the value is either found or the end of the sorted section is reached. This is much slower process in large arrays as it can take up to the length of the sorted section before finding the appropriate position within the sorted section of the array.

(ii) 2 marks
Unsorted:

659	68	101	3098	3	752	2098

Pass 1:

68	659	101	3098	3	752	2098

Pass 2:

68	101	659	3098	3	752	2098

Pass3:

68	101	659	3098	3	752	2098

Pass4:

3	68	101	659	3098	752	2098

Pass 5:

3	68	101	659	752	3098	2098

Pass6:

3	68	101	659	752	2098	3098

(iii) 5 marks
SAMPLE ONLY
BEGIN <u>MoveProductRecordInArray</u>

```
    Set Temp to Product [NewPos]
    Set Product (NewPos) to Product (CurrentPos)
    Set temp to Product (NewPos +1)
    Set  counter to NewPos+2
    WHILE counter<= Last index of ProdcuArray
        Set Prod(counter) to Product (counter +1)
            Increment counter
    ENDWHILE
END
```

Note: ( ) as in square brackets

(iv) 2 marks

The programmer used separate sub-procedures and functions to break the code into logical groupings. That is each sub-procedure performs only one task. This improves readability, reusability and reduces the chances of errors coming into the code when one part of the code is changed. Each sub-procedure works as a standalone module or unit and changes made in the other modules will not affect the sub-procedures.

(b) 4 marks

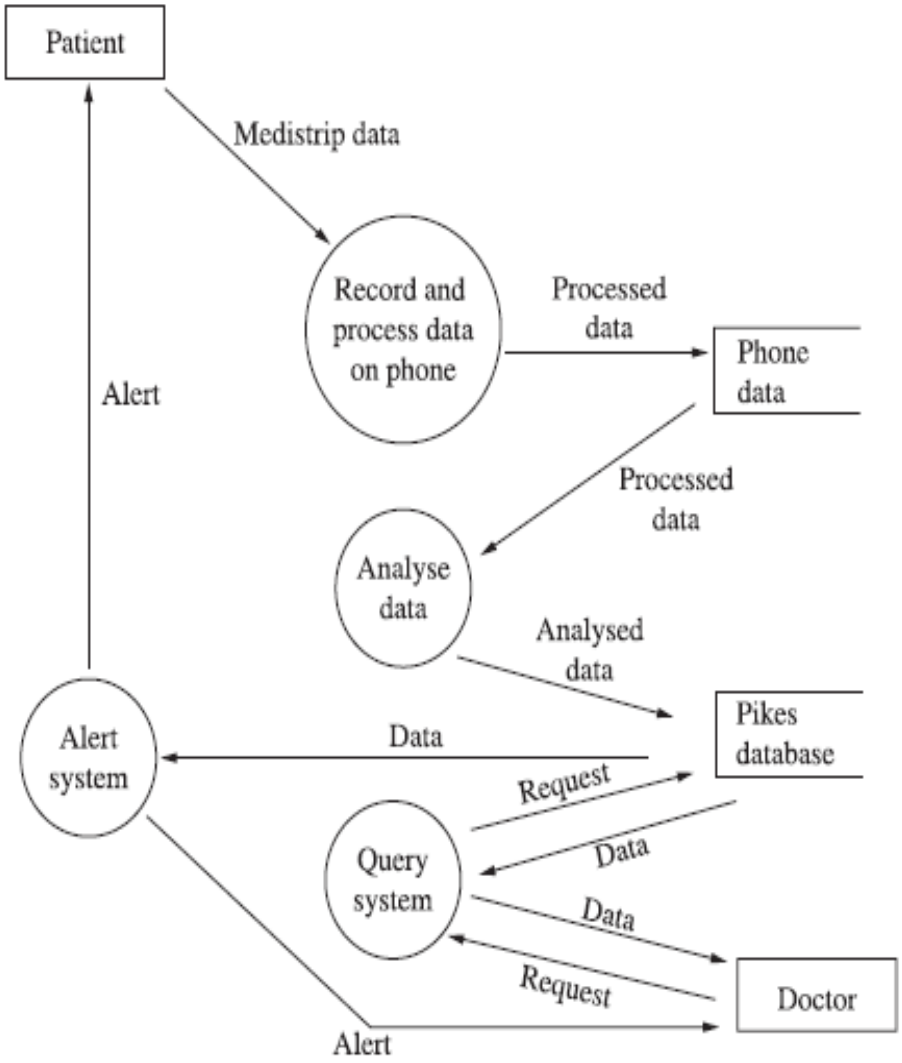
Sample answer:

```
BEGIN BalancePlane
        LeftCount = 0
        RightCount = 0
        FOR Row = 1 to 50
                FOR Column = 1 to 6
                        IF SeatArray (Row, Column) <> 0 THEN
                                IF Column < 4 THEN
                                        LeftCount = LeftCount + 1
                                ELSE
                                        RightCount = RightCount + 1
                                END IF
                        END IF
                NEXT Column
        NEXT Row
        IF RightCount > LeftCount count THEN
                Print 'Right side too many'
        ELSE
                IF RightCount < LeftCount THEN
                        Print 'Left side too many'
                ELSE
                        Print 'Balanced'
                END IF
        END IF
END BalancePlane
```

(c) 4 marks

Criteria	Marks
• Generates a substantially correct data flow diagram	4
• Shows an understanding of the system by drawing a data flow diagram with an external entity, a data store and more than one process	3
• Correctly uses a variety of data flow symbols OR • Provides a diagram that shows a good understanding of the system	2
• Shows some understanding of the structure of a data flow diagram by the correct use of a data flow symbol OR • Provides a diagram that shows some understanding of the system	1

Sample answer:



Q25:

(a) (i)2 marks

A method is an operation or process that is performed using the data defined for an object and any parameters passed when the method is called. Thus, for a client object, a method could be Add Client.

(ii) 3 marks

Encapsulation is a powerful feature of OOP in which programmers do not need to be aware of the internal detail of an object. This allows them to make use of relevant objects simply by using the exposed methods, without having to learn more about the underlying code within the object. It also allows the object to be modified and improved without requiring modules that previously used that object to be modified. This greatly reduces the maintenance effort required if objects need to be updated to reflect changing requirements.

(b) 3 marks

Sample answer: A limitation of the imperative paradigm is its difficulty in solving certain types of problems. OO is more suitable than imperative for many gaming programs due to the use of classes and subclasses using inheritance, encapsulation and polymorphisms. Logic is more suited to AI programs due to the availability of facts, rules and an inference engine. Another limitation is the need to specify code for every individual process. OO can use attributes and methods to cut down on large parts of the coding. Logic programs can use an inference engine to reduce the need for coding when searching through a database. ***Answers could include:*** • Difficulty of coding for variability and reusability – OO can make use of its objects and methods combined with a modular approach to make the code more variable and reusable

(c)
(i) 3 marks

The inference engine would make use of forward or backward chaining to reach a conclusion about the characteristics of a particular dinosaur based on a set of established facts, derived from the database, and a set of rules derived from the code.

(ii) ***4 marks***
dinosaur(allosaurus)
period(allosaurus, jurassic)
could_run(X):– dinosaur(X), legs(X, two)
could_eat(X, Y):– dinosaur(X), dinosaur(Y), type(X, carnivore), period(X, Z), period (Y, Z)

(d) 6 marks (2 marks each)

Inheritance refers to the ability of objects to take on the characteristics of their parent class or classes. Encapsulation refers to the isolation of an object from its environment, so that changes to objects can be made without affecting other parts of the system, as long as the interface to that object remains the same.

Polymorphism is the concept that allows different objects to be used or presented in different ways at run time, depending on the users' requirements at the time.
These features of the OO paradigm improve productivity by encouraging the reusability of code and improve maintainability of code. Inheritance allows parent class characteristics to be reused efficiently without having to redefine characteristics. Maintainability is improved because changes only need to be made to the parent class.

Encapsulation allows data types and their associated methods to be grouped together. Classes thus created can be placed in library and reused by other programs. If necessary, changes only need to be made within the class definitions.

Polymorphism allows different objects to use a particular behaviour or method, and behave differently when required. For example, circle.draw performs circle drawing function while square.draw performs square drawing function.
Methods can also be distinguished by the type and number of parameters passed to them. Productivity is improved because methods can be 'shared' thus reducing coding. Maintainability is improved because changes only need to be made to the methods for a single class. New methods can be built on those defined in similar classes to encourage reusability of code.

(e) (i) 1 mark

(i) get FullName (id_no):
get YearGroup (id_no):

(ii) 3 marks (USE THE CORRECT STRUCTURE)

```
sub-class TEACHER  {
  is a PERSON
  private –
            staffroom: string
            phonenumber: integer
            permanent: Boolean
  }
```

(f) 3 marks

The logic paradigm would be the most appropriate as Ms Chen needs to come up with some rules on how to classify the toys. The facts about the toys can be entered into Prolog system or some kind of expert system shell. Imperative and OOP not suitable because it needs algorithm and then code which explicitly describes how to solve the categorization problem. A different algorithm would be needed to solve each toy. So will take a long time to solve the problem and very complicated. (students responses)

(g) 2 marks

Backward chaining: assume the theory is true and then ask the questions to systematically verify the necessary rules are present.

Forward chaining: start from the beginning of the facts and rules and ask questions to determine which path to follow next to arrive at a conclusion.