Number: _____

James Ruse Agricultural High School

2022

HIGHER SCHOOL CERTIFICATE TRIAL HSC EXAMINATION

Software Design and Development

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

Total marks – 100

Section I Pages 2-8

20 marks
- Attempt Questions 1–20
- Allow about 35 minutes for this section

Section II Pages 9-26

60 marks
- Attempt Questions
- Allow about110 minutes for this section

Section III Pages 27-31

20 marks
- Attempt Question
- Allow about 35 minutes for this section

Number: _____

Section One: Multiple Choice (20 Marks)

1. Which of the following is a software debugging tool?
   (A) Flag
   (B) Breakpoint
   (C) Peer Check
   (D) Desk Check

2. Which of the following is NOT an example of a runtime error?
   (A) Division by zero
   (B) Arithmetic overflow
   (C) Incorrect number of parameters
   (D) Accessing inappropriate memory locations

3. A program creates a log file, where each login attempt (successful or unsuccessful) is written to the file. Once a month the file is read and analysed.
   Which of the most appropriate file type and access method for writing the log file?
   (A) Relative writing
   (B) Sequential input
   (C) Sequential output
   (D) Sequential append

4. An array contains the following contents:

5	20	6	2	17

Two passes of a sorting algorithm are performed, and the array contents are now:

5	20	17	6	2

Which sorting algorithm has been used?
(A) Insertion sort
(B) Bubble sort
(C) Binary sort
(D) Selection sort

5. During the development of a new interface for automatic teller machines, surveys will be undertaken to help improve the screen designs for customers.

   Which of the following would be the best group to survey for the development of this software?

   (A) Bank staff
   (B) Bank management
   (C) The disabled, aged and infirm
   (D) A representative sample of the public

6. The term *quality assurance* is used in relation to the development of software.

Which of the following best describes quality assurance?

(A) Ensuring the user can access the data
(B) Ensuring the software is of high quality
(C) Ensuring the system meets specifications
(D) Ensuring the user can access the source code

The following scenario applies to question 7 and 8.

A hotel consists of 50 floors and 24 rooms on each floor. A sensory system detects if each room is occupied.

7. Which of the following data types is most applicable to the variable which indicates the occupation status of a given room?

(A) Array
(B) String
(C) Integer
(D) Boolean

8. Which of the following data structures is most applicable to store just the occupancy status of all rooms?
(A) A simple variable
(B) A two-dimensional array
(C) A three-dimensional array
(D) An array of records

9. Ms. Chen has finished marking your exams and she is now sorting them into descending mark order on the room table.
She uses the following strategy:

1) The first paper is placed on the room table
2) The next paper is compared to the paper(s) on the room table to determine its correct position and the paper is placed in this position
3) Step 2 is repeated until all papers are on the room table

What type of sorting strategy was used?

(A) Selection sort
(B) Bubble sort
(C) Insertion sort
(D) Quick sort

10. The quality of a piece of software is determined by a number of criteria.

At which stage of the software development cycle should these criteria be identified?

(A) Defining and understanding the problem

(B) Planning and designing the software solution

(C) Implementing the software solution

(D) Testing and evaluating the software solution

Use the following information to answer Questions 11 and 12.

Consider the following code which operates on an array of integers called List, indexed from 1.

```
1   BEGIN Program
2       W = List(1)
3       X = 1
4       Y = List(1)
5       Z = 1
6       i = 2

7       REPEAT
8           IF List(i) > W THEN
9               W = List(i)
10              X = i
11          END IF

12          IF List(i) < Y THEN
13              Y = List(i)
14              Z = i
15          END IF
16          i = i + 1
17      UNTIL i > Number of elements in List
18      SwapElements (X, Z)          REM this swaps the values of the elements at X and Z
19  END Program
```

Number: _____

11. The array List originally contained

4	1	6	5	2	3

Which row of the table correctly shows the values of X and Z after the code has been executed?

	X	Z
(A)	1	6
(B)	2	3
(C)	3	2
(D)	6	1

12. Which of the following is the correct pseudocode for the SwapElements subprogram?

(A)
```
BEGIN
    SwapElements(a,b)
    temp = a
    a = b
    b = temp
END
```

(B)
```
BEGIN
    SwapElements(a,b)
    temp = List(a)
    List(a) = List(b)
    List(b) = temp
END
```

(C)
```
BEGIN
    SwapElements(a,b)
    a = b
    b = a
END
```

(D)
```
BEGIN
    SwapElements(a,b)
    List(a) = List(b)
    List(b) = List(a)
END
```

13. A sorting algorithm is being used on the following array elements.

    2 3 5 1 4

    After one pass the array contains

    2 3 4 1 5

    Which sorting algorithm is being used?

    (A) Binary
    (B) Bubble
    (C) Insertion
    (D) Selection

14. The screenshot below is from Microsoft website and shows the start of a list of Excel functions. The full list contains 478 functions.

Function name	Type and description
ABS function	**Math and trigonometry:** Returns the absolute value of a number
ACCRINT function	**Financial:** Returns the accrued interest for a security that pays periodic interest
ACCRINTM function	**Financial:** Returns the accrued interest for a security that pays interest at maturity
ACOS function	**Math and trigonometry:** Returns the arccosine of a number
ACOSH function	**Math and trigonometry:** Returns the inverse hyperbolic cosine of a number

Which term best describes this documentation?

(A) Tutorial
(B) User manual
(C) Reference manual
(D) Systems documentation

15. Eve is a technical assistant. Her boss told her to test a program. Eve knows what to do without understanding the internal processes. What is this method of testing called?

(A) Black Box testing
(B) White Box testing
(C) Alpha testing
(D) Live testing

16. 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
```

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.

17. The command STOP is used in a software language as a debugging tool to halt a program.
The program cannot resume until the debugging command RUN is issued. Of what is this an example?

(A) Program traces
(B) Resetting variable contents
(C) Stubs
(D) Use of breakpoints

18. A customer refuses to pay a developer because they claim that while the software runs, it doesn't meet their original needs. This could be avoided by specifically testing

(A) if the algorithms worked.
(B) by comparing the software to other similar packages.
(C) by comparing it to the original design specifications.
(D) if the code executes.

.

19. The use of header statements and comments throughout the source code

(A) slow down the compilation process.

(B) make maintenance easier.

(C) eliminate the need for CASE tools.

(D) cause the source code to execute faster.

20. During development of your major programming project you will have developed a Gantt chart. The purpose of this was to

(A) to model the system.

(B) manage the development process.

(C) test the operation of the algorithms and source code.

(D) record the user's requirements.

End of Section One

Number: _____

Section II Total: 60 marks

Question 21 15 marks

Refer to the following information when answering all parts of the question 21.

BusCo is implementing a new system for customers to purchase tickets. Instead of visiting a booth with a human operator all ticket sales will be from computerised vending machines.

When the customer arrives at the machine they select their destination bus stop or station on the touch-screen interface. It will then ask what kind of fare they wish to purchase (adult or concession). The screen will then display the fare payable, and the customer can either insert cash or their credit card into the machine.

- If they insert cash, the machine waits until the correct amount has been inserted.
- If they insert their credit card, the machine contacts the credit card gateway to authorise the transaction.

If the credit card payment is successfully processed or when sufficient cash is inserted, then the machine prints a ticket and shows a message on the screen asking the user to take their ticket. If the credit card is not successfully processed a message appears on the screen that the purchase has been cancelled and the machine returns to the original screen.

(a) Draw a context diagram to represent this system. (3)

(b) Draw a system flowchart to represent the system described in the scenario. (4)

(c) Describe two ways how the developers could ensure that this system and software is inclusive for people with disabilities. (4)

(d) One of the screens in the system will ask passengers to enter their destination, fare type and payment option. Design an appropriate screen for the collections of this information, make sure you also include screen design element justifications. (4)

Number: _____

Question 22 **15 Marks**

Consider the following EBNF description of a simple programming language called Objective-Y.

Letter = a | b | c
Digit = 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
Relation = < | > | = =
Operator = + | - | / | *
Constant = <Digit> {<Digit>}
Variable = <Letter>
Expression = <Variable> <Operator> (<Variable> | <Constant>) {<Operator> (<Variable> | <Constant>)}

Conditional Expression = <Variable> <Relation> <Constant>
Output Statement = PRYNT (<Variable> | <Constant>)
Assignment Statement = <Variable> := (Variable> | <Constant> | <Expression>)
Pre-test loop = WYLE [<Conditional Expression>]: {<Output Statement> | <Assignment Statement>} END WYLE

(a) Discuss the legality of the following assignment statement (2)

a = a+2-d*10

_____

_____

_____

_____

_____

(b)Draw a railroad diagram to represent an expression in this language. (3)

Expression = <Variable> <Operator> (<Variable> | <Constant>) {<Operator> (<Variable> | <Constant>)}

(c)

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)

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_____

_____

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

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_____

(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)

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(d) Translating source code into machine code makes the code understandable to the processor. Explain the process of translation from a high-level language to a low-level language. Use **diagram** to illustrate your answer. (4 marks)

Number: _____

Question 23 **10 Marks**

Use the following algorithms for (a) and (b)

Consider the following algorithms which both calculate the average of five numbers using different methods.

```
BEGIN AverageFive1(array)
    sum = 0
    length = number of items in array
    FOR i = 0 TO length - 1 STEP 1
        sum = sum + array[i]
    NEXT i
    AverageFive1 = sum / length
END AverageFive1

BEGIN AverageFive2
    sum = 0
    FOR i = 1 TO 5 STEP 1
        READ INPUT a
        sum = sum + a
    NEXT i
    AverageFive2 = sum / 5
END AverageFive1
```

(a) Complete a desk check of AverageFive1 assuming the following values are in the array: (3 marks)

15, 10, 8, 4,3

(b) Critically evaluate these two different approaches to solving the problem. (3 marks)

(c)

A sequential file called FoodData stores the names of students and their favourite food.

The following shows some of the contents of the file.

Ahmad, salmon
Betty, tuna
Charlie, whiting

Write an algorithm to display the favourite food of each student in the format shown below.

Ahmad likes salmon
Betty likes tuna
Charlie likes whiting

(4 marks)

Number: _____

Question 24 — 10 Marks

(a)
A real estate agency uses a system of three programs:

- Sell — list properties, record owner details
- Buy — search for properties, record buyer details
- Rent — calculate rent, record leasing information.

The agency has checked that the leasing information is correct, but tenants have reported that they have been charged too much rent.

Which level(s) of testing (system, program, module) should be used to isolate the error? Justify your answer. (3)

(b)
A database for a courthouse contains data about the various trials and hearings that will take place. The data includes:

- dates, times and locations
- the names of the presiding judges
- the names of jurors
- details of the accused.

A system is being developed to give stakeholders (e.g., witnesses, court staff and police) access to appropriate data, using touch screens in kiosks at the entrance to the courthouse as well as web-based access.

Compare the agile approach and an alternative approach, regarding their suitability for developing this system. (3)

(c)
A subroutine IsMatch(string, BigString) is needed to check if a string is found in a bigger string.

The following library routines are available:
• length(string) which returns the number of characters in the string
• extract(string, start, length) which extracts *length* characters from *string* beginning at character *start*.
If text = 'software', then extract(text, 2, 4) will return 'oftw'.

Design the algorithm for IsMatch(string, BigString). (4 marks)

Number: _____

Question 25 **10 Marks**

(a)

An employer requires a program to manage overtime hours worked. **5**

A file called Employees is used to store the details of each employee. Each record has the following structure.

EmpID	Integer
Name	String
OvertimeHours	Real
...	...

This file is a relative file, which uses the EmpID to locate the required employee record.

Details of employee overtime hours for each week are stored in a sequential file called Overtime. An example of the data is shown.

EmpID	Hours
21742	1.5
35217	2.0
56728	2.75
...	...

A valid EmpID is any 5 digit number.

Design an algorithm that does the following:

- reads the Overtime file
- validates the EmpID
- if the EmpID is valid
  - retrieves the correct record from the Employees file
  - updates their OvertimeHours
- if the EmpID is not valid prints an appropriate message.

Number: _____

(b)
An electronic book is to be developed. The book has 20 chapters. Chapter 1 has only one version. For each of the other chapters, there are three versions. At the end of each chapter (except Chapter 20), a brief description of each version of the next chapter is displayed, as a list of three options. The reader chooses a version of the next chapter from that list of options.

Write an algorithm to show the order in which the chapter versions are displayed, based on the reader's input. (3)

(c)
With so many changes in government policies in the recent months, such as jobseeker/ job keeper payment or free childcare services during the corona virus crisis, what impacts do they have on software developers working for the systems used by government such as Centrelink? Explain what changes are required to adapt to the new regulations and the impacts it has on the software used. (2)

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End of Section Two

Number: _____

Section III **20 Marks**

Question 26

(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. (2)

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(b) Facts and rules are the basic building blocks of the logical programming paradigm. (4 marks in total)

The following facts have been defined in Prolog.

feathers(finches)

feathers(parrots)

This means, both finches and parrots have feathers.

Create further Prolog facts and rules based on the following information:

Facts:

- Bats, parrots and finches have wings (1/2 mark)

_____

- Echidnas, parrots and finches lay eggs (1/2 mark)

_____

- Bats and cows give birth to live young (1/2 mark)

_____

- Cows, bats and echidnas suckle their young (1/2 mark)

_____

Rules:

- All birds lay eggs and have feathers and wings (1)

_____

- All mammals give birth to live young and suckle their young (1)

(In your answer, write down **"**Birds (X) :-" **AND** "Mammals (X) :-")

_____

(c) Consider the following in relation to object-oriented paradigm concepts:

All cars, buses and bicycles are vehicles. All vehicles have travelled a certain distance since new, have a particular number of wheels and seats, use some type of fuel, are able to move and can turn.

However, moving and turning cars and buses is quite a different process to moving and turning a bicycle. As a vehicle moves it travels a certain distance, and the distance travelled since new is stored within the vehicle's odometer. The only way to alter the value in the odometer is to move the vehicle.
Based on the above information:

(i) Describe an example of a class including its data and methods. (2)

_____

_____

_____

_____

(ii) Identify an example of inheritance and use your example to explain how inheritance improves the productivity of programmers. (2)

_____

_____

_____

_____

_____

(iii) Describe an example of polymorphism. (2)

_____

_____

_____

_____

_____

(iv) Identify an example of encapsulation and explain how encapsulation improves the ability to reuse code. (2)

_____

_____

_____

_____

_____

_____

_____

_____

(d) 2 marks each

The following fragment of code is written in the Object-Oriented paradigm for a program designed for a local gym to record customer details.

```
class Person{
    public -
        date_of_birth: date
        height: float
        name: string
        age():
            dob = this.date_of_birth
            today = GetDateFromOperatingSystem()
            age = today.getFullYear() - year
            if (today.getMonth() < month || (today.getMonth()
== month && today.getDate() < day)) {
              age--
            }
            return age
        end age
```

(i) Describe why in the code above the value of `age` is a method which derives its value from the `date_of_birth` attribute, and not an attribute itself.

_____

_____

_____

_____

_____

_____

(ii) The gym wishes to record the body mass index for every customer to assist with their fitness programs. The body mass index of a person is calculated by dividing the person's weight by the square of the person's height (BMI = weight/height * height).

Add the appropriate properties and method to calculate a person's BMI to this code.

~ End of the Trial Exam~

Number: _____

Number: _____

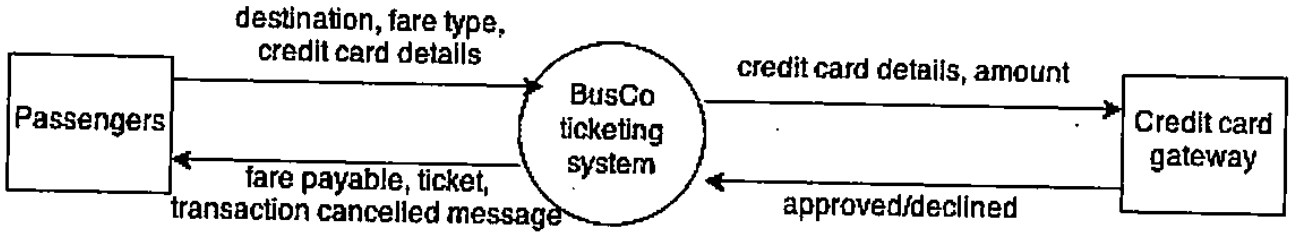
Answer: 2022 Trial

Part A:

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

(a) 3 marks

Draws a correct context diagram with correct use of symbols	3
Substantially context diagram using some correct symbols	2
Limited context diagram with some relevance to the scenario	1



(b) 4 marks

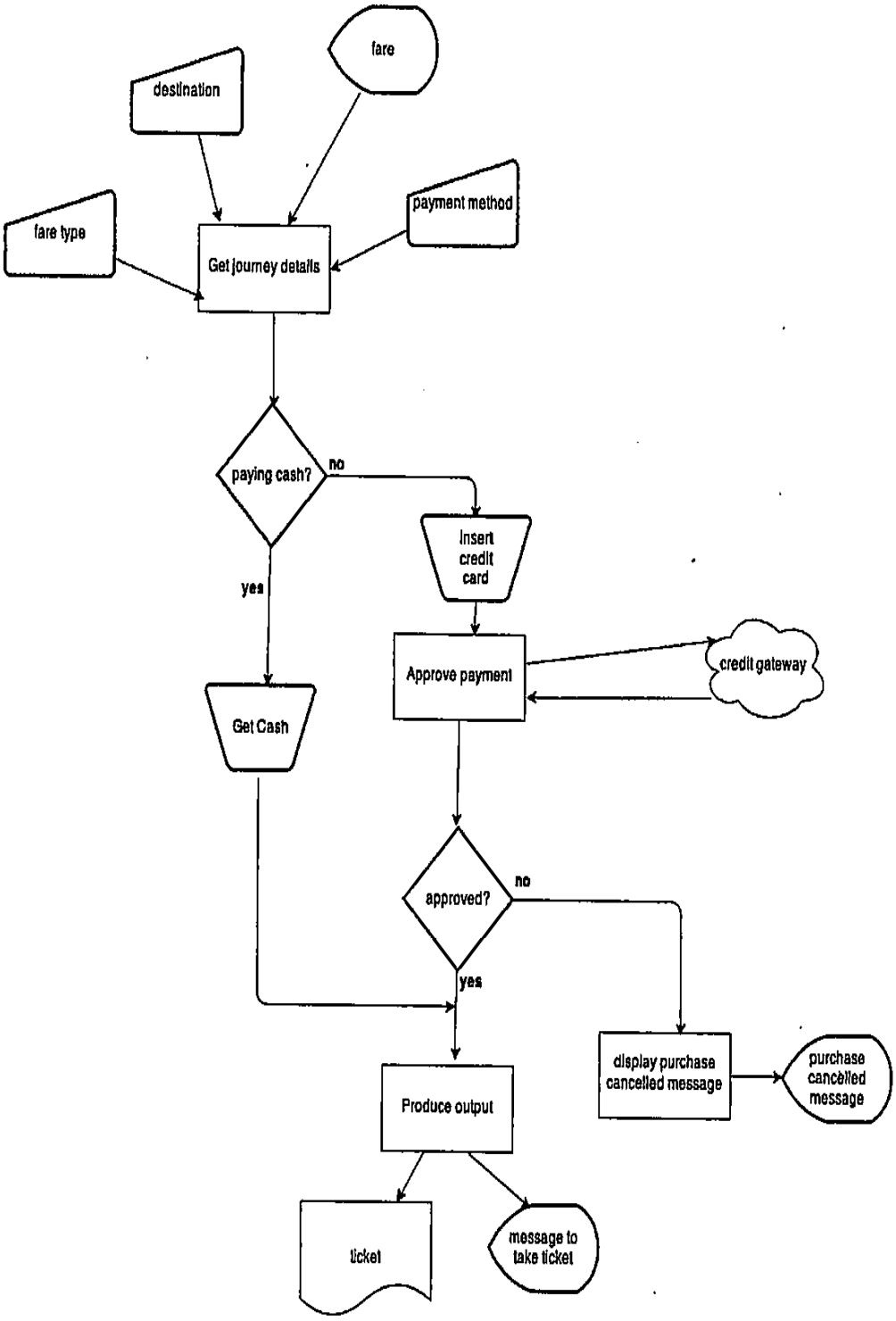
Sample answers, students need to expand on their methods

An alternate screen at a lower height should be offered for people using the system in a wheelchair. The coin/note/credit card insertion points should also be at a suitable height, as should the collection point for the printed ticket.

A screen reader option (text to speech) should be available for people with vision impairments. A button with braille e.g "press this button for assistance" could be used to activate the screen reader.

Number: _____

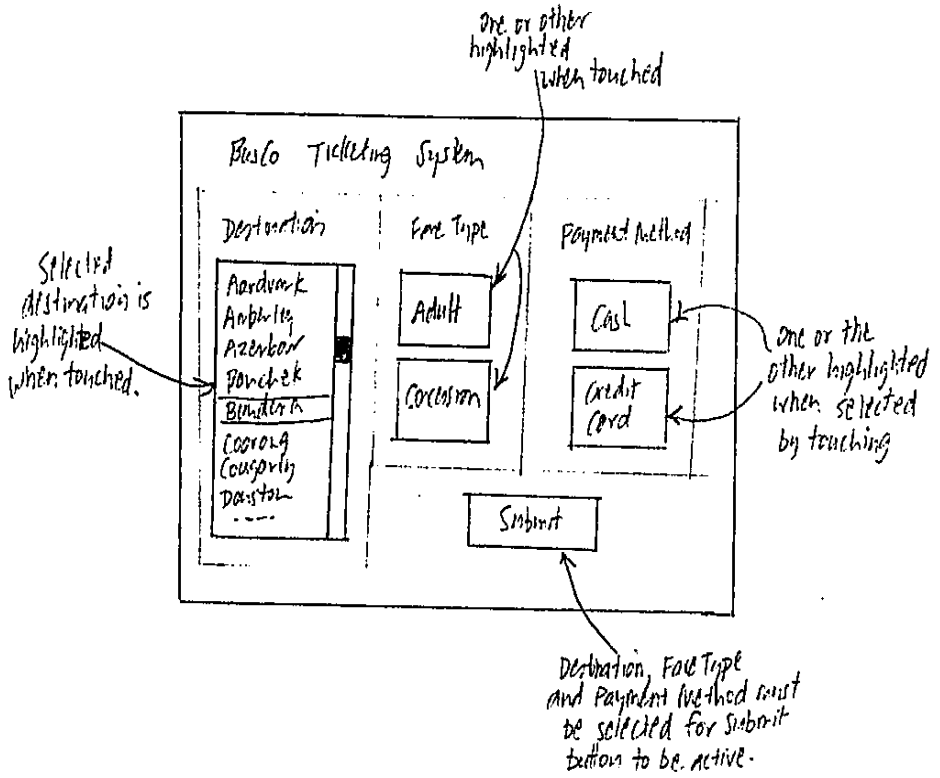
(c) 4 marks system flow chart
Sample only, symbols an logic need to match the question



Number: _____

(d) screen design (4)
Sample only

Provides a screen design showing a good understanding of screen design principles and screen elements.	4
Provides a screen design showing a sound understanding of screen design principles and screen elements.	3
Provides a screen design with appropriate screen elements.	2
Provides a screen design relevant to the scenario.	1



Q22 (15 marks)
(a) 2 marks

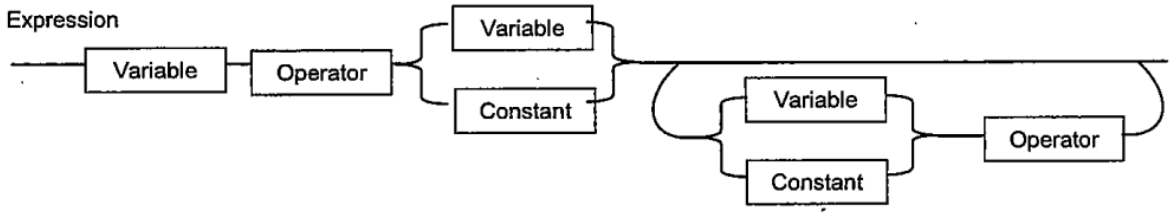
Marking Criteria	Marks
Discusses the legality of the statement and identifies the TWO problems.	2
Identifies at least ONE problem with the statement	1

This statement is not legal as there should be a colon : before the equals sign, and the expression is invalid as variables can only be the letter a, b, or c but the letter d has been used as a variable.

A corrected assignment statement would be:
a := a + 2 – b * 10

(b) 3 marks

Marking Criteria	Marks
Draws a correct railroad diagram.	3
Draws a substantially correct railroad diagram.	2
Limited railroad diagram with some merit	1



(c)(i) 2marks

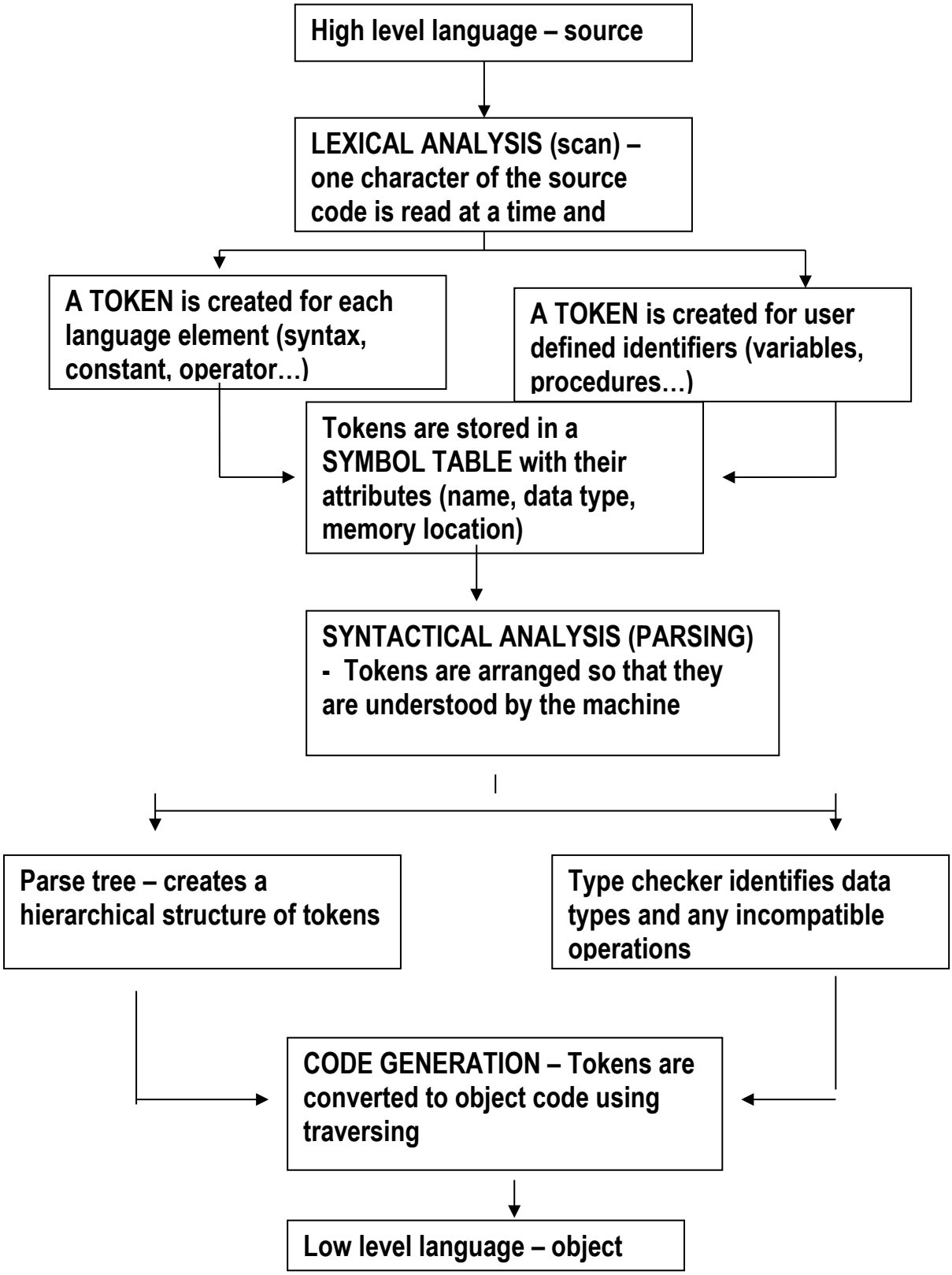
A register is a special high-speed storage area within the CPU. Manipulating data using registers within the CPU is
much faster than accessing RAM directly. All data must be represented in a register before it can be processed. For example, if two numbers are to be multiplied, both numbers must be in 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

(d)
4marks


High level language – source
LEXICAL ANALYSIS (scan) – one character of the source code is read at a time and
A TOKEN is created for each language element (syntax, constant, operator…)
A TOKEN is created for user defined identifiers (variables, procedures…)
Tokens are stored in a SYMBOL TABLE with their attributes (name, data type, memory location)
SYNTACTICAL ANALYSIS (PARSING) - Tokens are arranged so that they are understood by the machine
Parse tree – creates a hierarchical structure of tokens
Type checker identifies data types and any incompatible operations
CODE GENERATION – Tokens are converted to object code using traversing
Low level language – object

Number: _____

Q23

(a) 3 marks

Completes an appropriately formatted desk check that correctly predicts the expected output	3
Completes an appropriately formatted desk check that substantially predicts the expected output, but with some errors or omissions	2
Demonstrates some understanding of the logic in the algorithm	1

sum	*i*	*Length*	*Array (i)*	*AverageFive1*
0	0	5	15	
15	1		10	
25	2		8	
33	3		4	
37	4		3	
30				6

(b) 3 marks

AverageFive1 assumes that the array is already populated with values, starting from the 0th element, which may not actually be what the person using this routine expects or intends.

If the array contains only 1 element, then the FOR NEXT loop will not be entered (as (array length - 1) = 0), and Sum will remain at 0, causing the calculated average to be 0, rather than the expected answer of the value of the 0th element.

However, the algorithm is able to cope with an array of any length, which is more useful to the developer calling / making use of the routine.

The average calculated value needs to be returned to the calling routine for this routine to be useful to the developer using it.

AverageFive2 assumes that the data values are read in as a part of this called routine. This may not be relevant for a developer wanting to use this routine to calculate and return the average of the contents of an array that has already been populated. As with **AverageFive1,** the average calculated value needs to be returned to the calling routine for this routine to be useful to the developer wanting to make use of it.

The other problem with **AverageFive2** is that it assumes an array length of 5, which is very restrictive, as it is unlikely that all developers wishing to make use of this routine will only ever have 5 elements in their array. Even if a single developer has written this algorithm for their own use, and they currently only have 5 elements in their array, it is poor practice for subsequent maintenance to use the literal value 5 in their code. The approach means that if the requirements change and the array length needs to change, the maintenance programmer would need to look through the code in this routine to find both occurrences of the literal value 5 and be sure to change both to the newly required array length for the logic to work as expected.

it is clear that on balance, the algorithm **AverageFive1** is the preferred approach.

(c) 4 marks

Criteria	M
• Provides a correct algorithm that incorporates the following features: – OPEN / CLOSE file – Looping through the file, reading data – Terminating the loop at end of file – Correctly constructing and displaying the output	
• Provides an algorithm that attempts to address the main features of the problem	
• Provides an algorithm that shows understanding of file handling OR processing of data	
• Provides an algorithm that shows understanding of the problem	
• Shows some understanding of the problem	

Sample answer:

```
BEGIN
    Open FoodData for Input
    Read name
    WHILE NOT EOF
        Read food
        Display name "likes" food
        Read name
    ENDWHILE
    Close FoodData
END
```

Q24 (10)

(A) 3 MARKS

Sample answer: As the clients are being charged too much rent, it is likely that the error is in the rent program. Within the rent program, leasing information is said to be error free, which leaves the calculate rent module to be tested to ensure the calculation is free of logic errors. When this has been completed, program testing should be performed on the rent program to ensure that the data passed between the modules is error free and that the rent calculations are correct when compared against test data and expected output.

database. In conjunction with prototyping (for developing the user interface), the structured approach would be suitable here.

(c) 4 marks

Sample answer: Some secure data, such as names of jurors, should not be available to all stakeholders. There needs to be a hack-proof log-in system, with layers of data access, and automatic logout after a period of inactivity. The interface, and location of the touch screens, must allow access for the disabled and those of non-English speaking background. The legal system involves all kinds of people. There must be adequate response times as there may be many users needing to find the appropriate courtroom promptly. Accuracy is essential. The data must be updated regularly (and immediately if there's a change in a scheduled court appearance).

(c) 4 marks

Sample answer:

```
BEGIN IsMatch (string, BigString )
        Located = FALSE
        NumToCheck = length (BigString) – length (string) + 1
         FOR j = 1 to NumToCheck
                  Check = extract (BigString, j, length (string))
                   IF Check = string THEN
                            Located = TRUE
                    ENDIF
        NEXT j
        RETURN Located
END IsMatch
```

Provides a substantially correct algorithm that includes the following features: – Looks for a match in the description – Checks the required number of characters – Uses the library routines appropriately

Q25 (10 MARKS)
(A) 5 MARKS

Criteria	Marks
• Provides a substantially correct algorithm that includes the following features: – Reads every record in Overtime file – Validates the EmpID for each record – Retrieves the correct Employee record, using EmpID as the key – Updates the OvertimeHours in the Employee record with the amount from the Overtime record – Rewrites the Employee record using EmpID as the key	5
• Provides an algorithm that addresses most of the features	4
• Provides an algorithm that attempts to address some features	3
• Provides an algorithm that shows some understanding of the problem	2
• Shows some understanding of the problem	1

Sample answer:

```
BEGIN OvertimeUpdate
    OPEN Overtime for Input
    OPEN Employees for Relative access
        Read empID, Hours from Overtime
        WHILE not EOF
            IF EmpID is a number AND empID >= 10000 AND empID <= 99999 THEN
                Read recEmployee into Name, OvertimeHours using EmpID
                recEmployee.OvertimeHours = recEmployee.OvertimeHours + Hours
                Write recEmployee from Name, OvertimeHours using EmpID
            ELSE
                Display "Employee ID"  EmpID "is not valid"
            END IF
            Read empID, Hours from Overtime
        ENDWHILE
    CLOSE Employees
    CLOSE Overtime
END OvertimeUpdate
```

(b) 3 marks

Sample answer:

```
BEGIN
    Display book(1,1).chapter
    FOR chapterCount = 2 to 20
        FOR versionCount = 1 to 3
            Display book(ChapterCount, VersionCount).description
        NEXT versionCount
        Get versionChoice                    '1, 2 or 3
        Display book(chapterCount,versionChoice).chapter
    NEXT chapterCount
END
```

(c) 2 marks
Students response

Q26 (20 marks)

(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) 4 marks in total

facts ½ mark each and rules one mark each

Facts:
Wings (bat)
Wings(parrot)
Wings(finch)

LayEggs(echidna)
LayEggs(parrot)
LayEggs(finch)

LiveYoung (bat)
LiveYoung(cow)

SuckleYoung (cow)
SuckleYoung (bat)
SuckleYoung (echidna)

Rules:
Birds (X) :- LayEggs(X), Feathers (X), Wings(X)
Mammals (X) :- LiveYoung(X), SuckleYoung (X)

(c) 8 marks

(i)2 marks
A class could be created called Vehicle which would include the data (or attributes) Wheels, seats, fuel and odometer. Methods(or operations) would include turn and move.

(ii) 2 marks
Three sub-class (or child classes), say Car, Bus and Bicycle could inherit data and methods from the parent class Vehicle. This reduces the need to write the sub-classes from scratch as the code within the Vehicle class is reproduced within the sub-classes. In addition, once the code has been thoroughly tested it can be relied upon each time it is reused. The Bicycle class would have its own distinct Move and Turn methods rather than inheriting these from the parent Vehicle class.

(iii) 2 marks
Assume one object from each of the classes Car, Bus and Bicycle has been created. The methods Move and Turn can be used to manipulate all three objects. However the Move method for the Bicycle object performs quite different processing to the Move method of the Car and Bus objects. Similarly for the Turn method. Both the Move and Turn methods are said to be polymorphic.

(iv) 2 marks
Encapsulation means the value of data (attributes) of an object can only be altered by that object's methods. In the example the Odometer attribute can only be altered by the Move method of that object. Encapsulation allows programmers to create robust objects that are suitable for reuse. As data can only be changed by methods the programmer can test and validate all inputs thoroughly within the objects methods before any of the object's data is changed. This means unexpected inputs can always be dealt with gracefully by the object rather than causing errors to occur within the larger program.

(d) (i)

Suggested Answer:

The age of a person varies over time. To include the age of a person as an attribute would require that it be updated over time to accurately reflect the person's age. Including age as a method means that it would not require changing manually as it is calculated in real time based on the date_of_birth property.

(ii)

Suggested Answer:

```
class Person{
    public -
        date_of_birth: date
        height: float
        name: string
        weight: float
        age():
            dob = this.date_of_birth
            today = GetDateFromOperatingSystem()
            age = today.getFullYear() - year
            if (today.getMonth() < month || (today.getMonth() ==
month && today.getDate() < day)) {
              age--
            }
            return age
        end age
        bmi():
            return this.weight/this.height*this.height
}
```

End of 2022 trial

Number: _____