1 A company sells televisions over the Internet. The company keeps records in a computer file. Each record includes the following details about each type of television:

- TVNumber
- Description
- Price
- NumberInStock

The records are stored in ascending order of TVNumber.

(a) A new program is to be written to search for a television using its TVNumber. The programmer has been asked to use a binary search or a linear search.

(i) Describe the operation of a binary search. [3]

(ii) Describe the operation of a linear search. [3]

(iii) State, giving reasons, whether a binary or a linear search would be more efficient. [3]

(b) List the entries in the order they are accessed during a binary search for the record with TVNumber 43. The records stored have these TVNumbers:

27, 32, 41, 43, 81, 92, 101, 103, 109, 142, 164 [2]

(c) The records are to be resorted into NumberInStock order. One sort algorithm that could be used is an insertion sort.

(i) Show how these values for NumberInStock could be sorted into descending order using an insertion sort. 23, 17, 45, 3, 7 [3]

(ii) Another sort algorithm that could be used is a bubble sort. Describe the operation of a bubble sort and show how the values from (c)(i) could be sorted into descending order using this sort. [4]

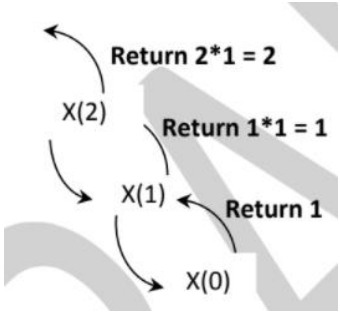
2 The recursive function X has one parameter, Index.

```
01 FUNCTION X(Index : INTEGER)RETURNS INTEGER
02 IF Index = 0
03 THEN
04 Y ← 1
05 ELSE
06 Y ← Index * X(Index – 1)
07 ENDIF
08 RETURN Y
09 ENDFUNCTION
```

(a) State what is meant by a recursive function. [2]

(b) Give the line number that indicates the function X is recursive. [1]

(c) An example of a trace tree diagram showing the recursive function call X(2) is shown as follows:



Use the above example to create a trace tree diagram for the recursive function call X(4). [4]

(d) Describe the purpose of function X. [1]

(e) Give one limitation of the function X. [1]

3 A car chase computer game has been designed for players aged 18 years and over. Part of the program to be designed and written, completes the following tasks:

- checks that a new player's name has not been used before
- stores the player's name and age in a binary search tree in alphabetical order of name
- provides an alphabetical list of all players

(a) The binary search tree that has its data inserted in the following order.

Ryan 18

Bella 21

Joshua 27

Shane 20

Jasmine 18

Alexis 27

Draw the binary search tree. [4]

(b) (i) Describe how the binary search tree in part (a) can be implemented using one or more arrays. [4]

(ii) Show the contents of this data structure. [2]

(c) (i) Using the binary search tree, describe how the program could check that a name has not already been used. [2]

(ii) Using the binary search tree in part (a), describe how the program would provide an alphabetical list of all players. Include in your description how the result from the binary search tree in part (a) would be obtained. [6]

4 Customers input the amount of money they want to withdraw from their bank account into an Automatic

Teller Machine (ATM). The ATM will dispense the money only if the amount is no more than the account balance and no more than the withdrawal limit on the account. The ATM will also check the amount of money held in the ATM, and offer the amount available if it is less than the amount requested. Otherwise

the transaction will be cancelled.

(a) Create a decision table to show these conditions and actions. [4]

(b) Remove the redundancies from the decision table. [2]

(c) Write pseudo-code to input the amount of money, check the account balance, the withdrawal limit, the amount of money in the ATM and then output one of these messages:

- "account balance exceeded"
- "withdrawal limit exceeded"
- "cash will be dispensed"
- “ATM can only dispense ” AmntATM

Use the variable names in table 4.1 in your pseudo-code. [10]

Name	**Use**
Amount	Amount of money input
AccBal	Account balance
WithLmt	Withdrawal limit
AmntATM	Amount of money in ATM

Table 4.1

5 A company rents holiday apartments to customers. A customer usually makes a booking a number of months before the start of the rental period. The customer pays a deposit at the time of the booking and the balance (the remaining money owed) a month before the start of the rental.

At the time of a booking, the company records the following data:

- customer name and address, if the customer has not made a booking before
- customer reference code
- booking date
- rental start date
- rental completion date
- apartment type
- deposit taken

Apartment types are coded as follows:

- A1 for one-bedroom apartment
- A2 for two-bedroom apartment
- A3 for three-bedroom apartment

Each apartment type has its own daily rental.

Each apartment has a unique number.

Each customer may make more than one booking.

(a) The company wants to model this application using a relational database.

(i) A database needs a number of tables to store the data for this application.

Draw the Entity-Relationship (E-R) diagram to show the tables in third normal form (3NF) and the relationships between them. [7]

(ii) A table description can be expressed as:

TableName (Attribute1, Attribute2, Attribute3, ...)

The primary key is indicated by underlining one or more attributes. Foreign keys are indicated by

using a dashed underline. Using the information given, write table descriptions for the tables you identified in part (a)(i). [7]

(iii) Explain the purpose of any foreign keys that have been used using the table descriptions you

wrote for part (a)(ii). [2]

(b) The company wishes to provide a global service with apartments all over the world that can be booked at very short notice. The database will be expanded to include a wider range of information. Each apartment may have different types of information stored about it. This information could include, video, audio and web pages. The company is investigating using a NoSQL Database Management System (DBMS) rather than a relational database.

State three reasons why the company may wish to choose a NoSQL DBMS. [3]

6 A company has many offices at different sites in many other countries. Each office is able to access data stored on the network servers at the company headquarters. The offices access data using the Internet.

~~(a) Describe two threats that could compromise company servers. For each threat explain how the servers and the data stored on them could be protected and identify any limitations of the protection. [8]~~

~~(b) Data transferred over the internet from the company headquarters needs to be kept secure. Explain the security features that should be used in order to ensure this data would be protected during transfer. [6]~~

7 Computing professionals are usually required to conduct themselves ethically. A company has asked you to write a code of conduct for the computing professionals employed by that company.

The areas of conduct that should be included in the company's computing professionals' code of conduct include:

- Integrity
- Responsibility
- Competence
- Professionalism

(a) Give one example of a rule that you would expect to be included in each area of conduct.

Each rule given must be different. [4]

(b) For two of your rules give an example of the unethical behaviour it is designed to prevent. [2]