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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION MAY 2022

INFORMATION TECHNOLOGY: PAPER II

EXAMINATION NUMBER [grid]

Time: 3 hours

150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

- 1. This question paper consists of 28 pages. Please check that your question paper is complete.
2. Read the questions carefully.
3. Answer on the question paper. Please write your examination number in the blocks above.
4. Answer ALL questions - there are no options in this paper.
5. Show all working where applicable.
6. A non-programmable calculator may be used.
7. It is in your own interest to write legibly and to present your work neatly.
8. One blank page (page 28) is included at the end of the paper. If you run out of space for an answer, use this page. Clearly indicate the number of your answer should you use this extra space.

FOR MARKER'S USE ONLY

Table with 9 columns: Question, 1, 2, 3, 4, 5, 6, 7, Total. Rows include Marks, Marked, and Moderated.

SECTION A SHORT QUESTIONS**QUESTION 1 DEFINITIONS**

Give the most appropriate term for each of the following expressions:

1.1 A zone for accessing a Wi-Fi connection for Internet access, often in a public place.

(1)

1.2 Software that adds functionality to a web browser.

(1)

1.3 A network device that determines the best path for packet transmission.

(1)

1.4 A type of website where information does not often change or update.

(1)

1.5 A technique for identification or authorisation that uses human characteristics to identify a person.

(1)

1.6 A generic term for a variety of malicious code that can attack hardware or software or that can be used to steal personal information.

(1)

1.7 A protocol for sending and receiving email where email messages remain on a central server.

(1)

1.8 A device that is used to connect network segments and can reduce network traffic.

(1)

1.9 A value that represents the sum of a series of values used to check for errors in data transmissions.

(1)

1.10 A product/security tag that includes a lower-power radio transmitter.

(1)

10 marks

SECTION B SYSTEM TECHNOLOGIES

QUESTION 2 THEORY – MATCHING COLUMNS

For each of the terms in Column A below, you should select the **most correct** definition in Column C, matching the letter to the question number. You should merely write down the appropriate letter in Column B. An example is shown as Question 2.0, using "W" as the correct answer.

Column A		Column B	Column C
2.0	Computer term	W	A A device that synchronises all internal components of a computer.
2.1	Hybrid drive		B A storage location for the current instruction on the CPU.
2.2	System clock		C A process of backing up data and moving it to a different location.
2.3	CMOS		D A technique to enable fast context switching to improve CPU performance.
2.4	Driver		E An interface that provides for the storage of initialisation data required at boot time.
2.5	UEFI		F A storage device that combines solid state and mechanical storage systems.
2.6	Archive		G A mechanism for improving the time it takes to read from or write to a hard disk.
2.7	Multi-threading		H Software that forms an interface between a hardware device and the operating system.
2.8	Register		I An electronic non-volatile computer memory storage medium that can be electrically erased and reprogrammed.
2.9	Hyper-threading		J A technique that employs two or more physical processing units.
2.10	Flash memory		K A storage device that is used for cloud storage.
			L A technique that allows portions of code to be executed at the same time.
			M A technique for backing up data.
			N A type of chip that requires a constant power source to retain its contents.
			O A piece of software that drives the management of data in a computer system.
			P A piece of low-level software that is activated when you start your PC.

[10]

SCENARIO







Consider the following scenario when answering the rest of the examination paper, unless otherwise stated or the questions are of a general nature.

Home-to-Home is a company that rents holiday homes. They do not own the homes but rent them out on behalf of the owners. The homes vary in size. **Home-to-Home** operates out of a small office with a few employees managing bookings, which are all made via an interactive website.

Home-to-Home is owned and managed by Thulani and Imraan.

QUESTION 3 APPLICATION

The **Home-to-Home** office has a server and several desktop PCs. The specifications of the server are shown below:

-  CPU Size: Intel Xeon Silver 4208 2.1GHz, 8 Cores /16 Threads, 9.6GT/s, 11MB Cache, Max RAM: 1TB
-  Memory Pre-Installed: 16GB
-  Hard Drives Pre-installed: 1 × 4TB 7 200 RPM 12Gbps Hard Drive Hot Swappable (Max 12 drives), RAID controller
-  Power Supply: Single 495W
-  Onboard Network Card up to 1Gb/s
-  4 USB 3.0 ports

3.1 The server has 4 USB 3.0 ports.

3.1.1 Does USB 3.0 allow faster or slower data transfer than USB 2.0? Tick the box next to the correct answer.

Faster

Slower

(1)

3.1.2 Name TWO peripheral devices that are likely connected to this server via USB.

Device 1: _____ (1)

Device 2: _____ (1)

3.2 The server is using Windows Server 2016 as its operating system.

3.2.1 Name the company that produces this operating system.

(1)

3.2.2 Name one other operating system that could be used on this server.

(1)

3.2.3 All software, including an operating system, is distributed under some form of licence agreement. Complete the table below for the operating system being used on the server as well as the operating system that you chose in Question 3.2.2 above.

Name	Windows Server 2016	Your operating system
Licence model (Proprietary/Open source)		
Free or paid?		
Can the code be altered?		
Can you distribute copies?		

(4)

3.3 The server currently has one hard drive installed. **Home-to-Home** would like to make use of the RAID using the installed RAID controller that supports RAID level 1 and RAID level 5.

3.3.1 Compare RAID level 1 and RAID level 5 using the table below to help you to decide which level to use. You are required to tick the appropriate boxes.

RAID 1	RAID 5
<input type="checkbox"/> Uses mirroring	<input type="checkbox"/> Uses mirroring
<input type="checkbox"/> Uses striping	<input type="checkbox"/> Uses striping
<input type="checkbox"/> Uses mirroring and striping	<input type="checkbox"/> Uses mirroring and striping
Minimum number of drives needed: <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3	Minimum number of drives needed: <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3
<input type="checkbox"/> Uses parity	<input type="checkbox"/> Uses parity

(5)

3.3.2 'Using RAID does not provide a complete solution to data loss.'

- (a) Explain to someone who believes that RAID will always provide total protection what is meant by this statement.

(2)

- (b) What other process should take place in addition to using a RAID controller?

(1)

3.4 The server has a 64-bit processor.

- 3.4.1 Which of the following will allow a correct calculation of the number of locations a 64-bit processor can address? Tick the correct box.

2^{64} 2^{64-1}

(1)

- 3.4.2 List TWO factors that will limit the amount of RAM that can be used in any server or desktop PC.

Factor 1: _____

(1)

Factor 2: _____

(1)

3.4.3 The server has 16 GB of RAM installed. When operating, the server might need more RAM than is physically installed.

- (a) Name ONE technique that can be used to 'increase' the amount of memory available when the sever is operating.

_____ (1)

- (b) Which hardware component would be used to support the technique you suggested in (a) above?

_____ (1)

3.5 The processor is shown to have 11 MB of cache memory.

3.5.1 What is stored in processor cache?

 _____ (2)

3.5.2 Which part of the CPU interacts with the CPU cache?

 _____ (1)

3.5.3 Which of the following are examples of how cache memory makes the operation of a CPU more efficient? Choose TWO correct statements by ticking the appropriate boxes.

- Gives the CPU quicker access to the instructions it needs
 - Reduces CPU latency
 - Increases the speed of RAM–CPU data transfers
 - Reduces the number of instructions sent back to RAM
 - Reduces the number of CPU cores needed
- (2)

3.6 The server has a single power supply. If the power supply fails, the server will be unable to perform the tasks needed for the business to operate. One solution might be to install a UPS.

3.6.1 What is a UPS? You are NOT required to expand the abbreviation as part of your answer.

(1)

3.6.2 Explain why a UPS alone will be insufficient as a solution to power failures.

(1)

3.6.3 Name and explain ONE other PC hardware solution.

(1)
[30]

40 marks

SECTION C INTERNET AND COMMUNICATION TECHNOLOGIES

QUESTION 4 THEORY

For each of the questions below, you need to select **the most appropriate answer** from the options A–D. There is an answer grid at the bottom of each of the next two pages, each for five questions. Write down the appropriate letter for your answer.

4.1 ARP is a protocol that ...

- A allocates IP addresses to clients on a network.
- B connects IP addresses and MAC addresses in a LAN.
- C manipulates MAC addresses.
- D defines data transmission.

4.2 A ring topology ...

- A uses more cable than a star network.
- B can only use coaxial cable.
- C requires a central switch.
- D will be disrupted when clients are added.

4.3 A network interface card (NIC) ...

- A does not contain a CPU.
- B is always built into the motherboard of a PC.
- C removes some processing from the main CPU.
- D None of the above.

4.4 Web 2.0 ...

- A was introduced to allow for faster web access.
- B allows for interactive content on web pages.
- C is only available via desktop browsers.
- D blocks SEO.

4.5 Firewalls ...

- A are used to secure access to and from a network.
- B must be implemented through a hardware device.
- C are used to prevent data loss in a server room.
- D require special cooling to operate.

Question	4.1	4.2	4.3	4.4	4.5
Answer					

4.6 Tor browsers ...

- A are only used for non-legitimate reasons.
- B are designed to anonymise web surfing.
- C only work in combination with a normal web browser.
- D cannot be used on a mobile device.

4.7 Lossy compression ...

- A is used to promote digital music.
- B is only used for compressing audio files.
- C provides high levels of compression.
- D None of the above.

4.8 The WebDAV protocol ...

- A is an extension of HTTP.
- B prevents online collaboration.
- C does not allow for editing of files shared under the protocol.
- D only works on local area networks.

4.9 Private keys ...

- A are used to encrypt data transmissions.
- B work in combination with public keys.
- C are used in cryptocurrencies.
- D All of the above.

4.10 GPS ...

- A provides highly accurate data for all users.
- B is the same as LBS.
- C uses satellites to determine a location.
- D only works in vehicle navigation.

Question	4.6	4.7	4.8	4.9	4.10
Answer					

[10]

QUESTION 5 APPLICATION

5.1 When we consider an Ethernet network, we often use the terms 'packets' and 'frames'.

5.1.1 The header of a packet is usually associated with the basic information about the packet. Two items that form part of the header are the **protocol** and the **packet number**. Explain the need for each of these two items.

Protocol: _____
 _____ (1)

Packet number: _____
 _____ (1)

5.1.2 Which TWO items are added to a packet to form a frame to assist with delivery of the payload?

Item 1: _____

Item 2: _____ (2)

5.1.3 Frames commonly contain a *Frame Check Sequence (FCS)*.

(a) Why is an FCS included in a frame?

 _____ (1)

(b) Name the algorithm that is commonly used to create the FCS.
 _____ (1)

- (c) The binary sequence shown below represents the data portion of a particular frame:

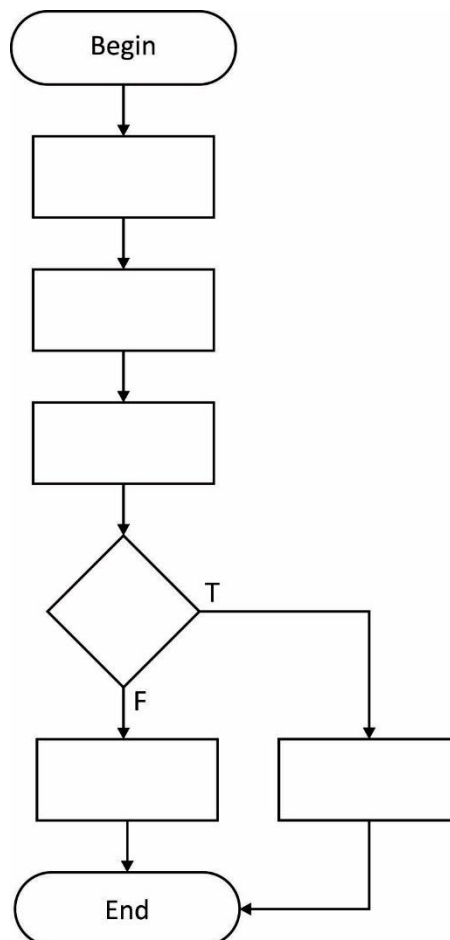
1 0 0 1 0 0 1 1

What is the value of the ninth parity bit that will be added to this byte if EVEN parity is used?

(1)

- (d) The following points labelled A–F are part of a process in checking to see whether the data in a frame has been correctly transmitted. You are required to complete the flowchart below by entering the correct letter in each box to correctly explain the process.

- A Transmit the frame
- B Sender calculates parity and enters this into frame
- C Request frame to be re-sent
- D Do parity calculations match?
- E Receiver calculates parity from received frame
- F Frame OK



(5)

5.2 Network clients can be categorised into two main types: thin clients and fat clients. The office network of **Home-to-Home** currently makes use of fat clients. Thulani and Imraan wish to consider changing some of these to thin clients and require some information to assist them in their decision.

5.2.1 Complete the table below to assist Thulani and Imraan. It is sufficient to answer "Yes" or "No" for some factors. Be guided by the space allocated for your answers.

Factor	Thin client	Fat client
Contains a hard drive (Yes/No)		
Contains a network card (Yes/No)		
Where are applications stored and run?		

(4)

5.2.2 Consider the specifications of the current server that **Home-to-Home** is using. List TWO components that you believe will be the most essential to upgrade should the business decide to change to thin clients. Justify your choices.

Component 1: _____

_____ (1)

Justification: _____

 _____ (2)

Component 2: _____

_____ (1)

Justification: _____

_____ (2)

5.2.3 A third type of client is known as a smart client. When implemented, where is the data that a smart client uses stored?

_____ (1)

5.3 The website that **Home-to-Home** uses makes use of cookies.

5.3.1 Where is a cookie stored when a user accesses the remote **Home-to-Home** website?

_____ (1)

5.3.2 Give TWO examples of the data that might be stored in a cookie generated by **Home-to-Home's** website.

Example 1: _____
_____ (1)

Example 2: _____
_____ (1)

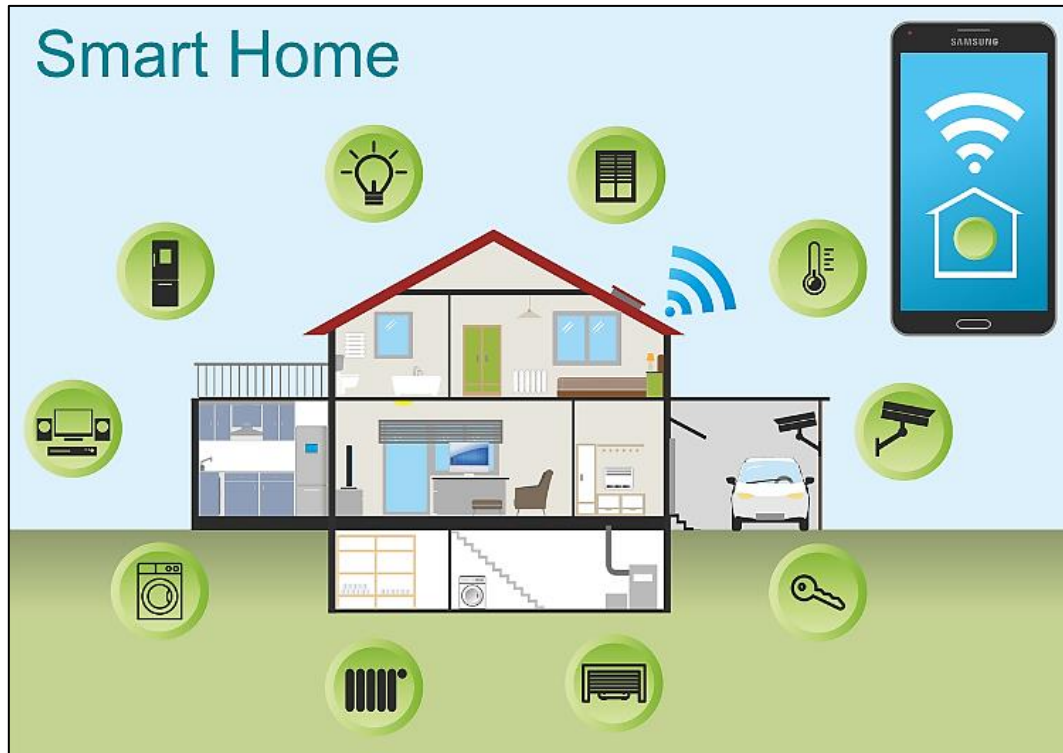
[26]

36 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 6

Study the image and the text below that relate to the use of IoT (Internet of Things) technologies.



This image shows a number of devices in a home that can be controlled by an app on a mobile device. However, such devices can be vulnerable to attack.

Attacks against Internet of Things (IoT) devices and networks have been escalating throughout 2018 with 32,7 million IoT attacks having been detected in the last year while phishing saw a decrease in volume.

Many of the estimated 31 billion IoT devices that will be installed in 2020/2021 will come with easy-to-abuse or no security controls.

This allows malicious people to compromise and add these devices to large-scale botnets they control by exploiting security flaws in individual devices.

The fact that IoT manufacturers failed to implement proper security controls to protect these types of devices from remote attacks allowed the number of IoT attacks to increase during last year by 217,5% from the 10,3 million logged in 2017.

[Adapted from: <<https://www.bleepingcomputer.com/news/security/iot-attacks-escalating-with-a-2175-percent-increase-in-volume/>>]

6.1 What is meant by the phrase *Internet of Things (IoT)*?

(1)

6.2 The text mentions '... manufacturers failed to implement proper security controls ...'. Explain a possible failed security measure and the possible consequence of this.

Failed Security Measure: _____

Consequence: _____

(2)

6.3 The image on the previous page shows a number of smart devices. The table below lists two of these devices. Complete the table by listing ONE advantage and ONE disadvantage of each of the devices being Internet-linked. You may use an advantage/disadvantage only ONCE and the advantage/disadvantage may not be opposites of each other.

Device	Advantage	Disadvantage
Heating		
Security cameras		

(4)

6.4 **Home-to-Home** is considering installing IoT devices in the properties they rent for customers. Explain how the following two factors will assist in improving the security of these devices:

Using complex passwords on devices:

(1)

Placing the devices on a different VLAN to the one used by clients in their properties:

(1)

6.5 Big Data is a concept that gets much attention.

6.5.1 Explain why Big Data and IoT are often connected as concepts.

(1)

6.5.2 If IoT didn't exist, would Big Data continue to exist? Justify your answer with ONE reason.

Tick the box next to the correct answer.

Yes

No

(1)

Justification: _____

(1)

6.6 Two concepts that are often seen as being the same are the Deep Web and the Dark Web.

Distinguish between the concepts *Deep Web* and *Dark Web*.

(2)

14 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 7

7.1 Stored data is often subject to threats. Two examples of threats to quality data are **corrupted data** and **invalid data**. Complete the table below to show ONE cause and ONE solution for each threat.

Threat	Cause	Solution
Corrupted data		
Invalid data		

(4)

7.2 Databases and data warehousing differ in terms of how they store and process data. For each of the following features, indicate whether the feature applies to databases, data warehousing or both. Answer this question by ticking appropriate boxes. You may tick only ONE box per feature.

Feature	Database	Data warehouse	Both
Records data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Uses multiple data sources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contains historical data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(3)

7.3 Data warehousing is similar to the process of data mining. Which of the following features do you associate with **data mining** and which with **data warehousing**? Tick the box next to the relevant words for each concept. You may tick only ONE box per feature.

Feature	Data mining	Data warehousing
Extracts useful data from large data sets	<input type="checkbox"/>	<input type="checkbox"/>
Stores unstructured data	<input type="checkbox"/>	<input type="checkbox"/>
Recognises patterns	<input type="checkbox"/>	<input type="checkbox"/>

(3)

7.4 **Home-to-Home** is developing an OOP solution to assist with managing their properties. This solution will consist of a number of classes.

The Property class

This class will be used to instantiate **Property** objects, each object representing one property that **Home-to-Home** can rent out. A **Property** object will have the following fields:

- ownerName: string
- address: string
- beds: integer

These fields should not be accessible from outside the **Property** class.

The Booking class

This class will be used to instantiate **Booking** objects. Each **Booking** object will be used to store up to three bookings, which can be for different properties. A **Booking** object will have the following fields:

- name: string
- bookingDate: array of up to three strings (start and end date combined)
- propertyBooked: array of up to three **Property** objects

These fields should not be accessible from outside the **Booking** class.

7.4.1 Complete the following class diagrams for the **Property** and **Booking** classes. Show the declaration of all the fields of the classes as well as the following methods:

Property class

- Parameterised constructor method accepting the following parameters: **oN** (string), **a** (string), **b** (integer);
- Accessor method for the **ownerName** field;
- Mutator method for the **beds** field, which will accept the parameter **b** (integer);

- A **toString** method.

Booking class

- Parameterised constructor method that accepts parameters: **rN** (string), **bD** (array string) and **pB** (array of **Property**).
- Accessor method for the **Name** field. This method will return a single string.
- A **toString** method.

Property
Fields:
Methods:

Booking
Fields
Methods

(10)

7.4.2 In the class diagram in Question 7.4.1, you wrote definitions for some methods.

What is the purpose of a:

toString method?

(1)

mutator method?

(1)

7.4.3 The **bookingDate** field is stored as a string. This string contains the start and end dates of a particular booking. An example of a string might be:

21-04-2021:28-04-2021

This means the person who made the booking will arrive on 21 April 2021 and leave on 28 April 2021.

- (a) Give an example of ONE method that can be added to the **Booking** class to assist in making better use of the **bookingDate** field. Explain why this method will be useful when processing **Booking** objects.

Method:

(2)

- (b) Will the method you gave in (a) above be a private or public method?

(1)

- (c) A String is not the most suitable data type to store both the start and end dates for a booking. Suggest a more suitable data type.

(1)

7.4.4 The **Property** and **Booking** classes both have constructor methods.

Explain why this is NOT an example of method overloading.

(1)

7.5 Further application development took place and the **Property** class was further enhanced. There are two new fields in the class: **isBooked** (Boolean), which indicates whether a particular property is currently booked, and **discount** (integer), which shows the current discount available when booking the property.

Together with the **beds** field these fields can be used to determine if a particular property is suitable for someone who wants to make a booking. For example, a person might be looking to book a property that is available, has six beds, or is currently offering a 10% discount.

Let: I = isBooked (true), D = 10% discount, B = has 6 beds

We could write a Boolean expression for this condition as: NOT(I) AND (D or B) in other words $F(I,D,B) = \neg I \cdot (D + B)$

You are required to complete the truth table below to represent the condition shown above.

I	D	B	I'	D OR B (D + B)	I' AND (D OR B) I' (D + B)	RESULT True/False
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

(8)

7.6 Consider the following algorithm that is being used as part of a class that operates on an array of Booking objects, **bArr**. The method is being used to find bookings made by a particular person. The parameter represents the name being searched for, and the method will return the position of the booking in the array.

```

method search (string inName)

1   i ← 0
2   flag ← false
3   size ← number of elements in bArr
4   pos ← -1
5   while ( i < size AND flag = false )
6       if ( inName = bArr[i].getName() )
7           pos ← i
8       end if
9       flag ← true
10      i ← i + 1
11  end while
12  return pos
    
```

7.6.1 Explain the function of the Boolean variable, flag, in this algorithm.

(2)

7.6.2 The array (**bArr**) MUST be sorted before this algorithm can work effectively. Is this statement True or False?

(1)

7.6.3 Consider line 4 of the algorithm. Explain why this variable (pos) is given an initial value of -1.

(2)

7.6.4 This algorithm has been coded, but it does not produce the correct results. You need to complete the following trace table to show what the algorithm is doing. Include the line numbers as reference to the line of code that is being tested. There are more lines on the grid than are necessary for a correct answer.

To test the algorithm, assume the following names exist in **Booking** objects:

Object[0].getName()	Object[1].getName()	Object[2].getName()	Object[3].getName
Zodwa	Peter	Agnes	Joe

Assume furthermore that the parameter receives the value 'Agnes' and that the number of elements in **bArr** is 4.

Line	inName	i	flag	size	pos	i<size AND flag=false?	inName = bArr[i].getName()?
Return value of pos:							

(10)

50 marks

Total: 150 marks

