Please paste the barcoded label here

TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2023

INFORMATION TECHNOLOGY: PAPER II

EXAMINATION NUMBER

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 32 pages. Please check that your question paper is complete.
2. Read the questions carefully and make sure that you answer all parts of all the questions.
3. Answer on the question paper. Please make sure that you write your examination number in the blocks above.
4. Show all working where applicable.
5. A non-programmable calculator may be used.
6. It is in your own interest to write legibly and to present your work neatly.
7. FOUR blank pages (page 29–32) are included at the end of the paper. If you run out of space for a question, use these pages. Clearly indicate the number of your answer should you use this extra space.

FOR MARKERS' USE ONLY

Question	1	2	3	4	5	6	7	**Total**
Marks	5	10	28	5	32	21	49	**150**
Marked								
Moderated								
Remark								

SECTION A SHORT QUESTIONS

QUESTION 1 DEFINITIONS

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

1.1 A bus that carries binary signals between the processor and RAM.

_____

(1)

1.2 A piece of low-level software on a modern PC that starts when you boot your PC.

_____

(1)

1.3 A network of connected smart devices that exchange small amounts of data with other devices using the Internet.

_____

(1)

1.4 The use of technology to harass, threaten, embarrass or target another person.

_____

(1)

1.5 An open-standard file format that uses data pairs.

_____

(1)

5 marks

SECTION B SYSTEM TECHNOLOGIES

QUESTION 2 THEORY

Match the description in Column C to a term in Column A. Write your answer in Column B. 2.0 is included as an example.

Question	Column A	Column B	Column C	
2.0	Computer term	Z		
2.1	System clock		A	The time taken for data to travel between hardware components or devices.
2.2	SRAM		B	Universal Selling Bay.
2.3	SSD		C	A type of programming language that uses English-like commands.
2.4	Decode		D	A process that uses part of secondary storage as primary storage.
2.5	IRQ		E	A component that regulates the internal components of a computer.
2.6	Virtual memory		F	Semiconductor Random Access Memory.
2.7	High-level language		G	A general term for any form of technology that is easily transported.
2.8	Mobile technology		H	A storage device that has no moving parts.
2.9	USB		I	A programming language that uses commands similar to processor instructions.
2.10	Latency		J	A signal sent by a hardware device or software to the CPU.
			K	Part of the machine cycle.
			L	Part of the CPU that is used to keep the real time in 24hr format.
			M	A type of high-speed RAM.
			N	An interface for connecting peripheral devices and supplying power between devices.
			O	Memory that does not exist.

[10]

SCENARIO

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

Start2Travel is a new company being set up to allow members of the public to book air and bus tickets within South Africa to support post-pandemic travel. The owner and all employees work from home, i.e. there is no central office for the company.

QUESTION 3 APPLICATION

The owner of **Start2Travel** needs to purchase a computer that will handle all the booking requests received by the company. Employees who assist with bookings will also connect to this computer.

3.1 The owner has seen adverts for computers, some classified as servers and others as desktops.

3.1.1 The specifications of the servers and desktops are similar in many respects. Name TWO standard hardware components <u>on the motherboard</u> that are common to both.

Component 1	Component 2

(2)

3.1.2 A server will need to have certain specifications that will enable it to undertake more powerful tasks. You need to:

- Name TWO <u>motherboard components</u> that are likely to have a higher specification in a server than in a desktop.
- Give a probable specification for each <u>component</u>.
- Justify why the specification will need to be higher than in a desktop.

	Component 1	Component 2
Name		
Specification		
Justification		

(6)

3.2 The owner needs advice on choosing a processor for the desktop or server he will buy. Assist him by answering these questions.

3.2.1 Name the TWO most reputable manufacturers of CPUs for servers/desktops.

Manufacturer 1	Manufacturer 2

(2)

3.2.2 The owner has not yet chosen an operating system. Will the choice of CPU manufacturer affect the operating system he chooses? Justify your answer with ONE reason.

YES ☐ NO ☐

(2)

3.2.3 Modern computers include a graphics processor.

(a) Give ONE reason why computers have onboard graphics processors.

(1)

(b) Name TWO types of applications that generally benefit from an additional graphics processing unit (GPU). You are NOT required to give the names of specific applications.

Type 1	Type 2

(2)

(c) Will the server/desktop that **Start2Travel** purchases need a dedicated GPU? Justify your answer with ONE reason.

YES ☐ NO ☐

(2)

3.2.4 Modern CPUs make use of multiprocessing to enhance performance.

(a) Define *multiprocessing*.

(2)

(b) Explain how multiprocessing will improve the performance of the system that **Start2Travel** uses.

(2)

(c) Explain why multiprocessing requires operating system support to utilise this processor functionality.

(1)

3.2.5 A CPU with the following specifications was chosen for the new system.

Cores:	9
Threads:	24
Maximum frequency:	5.10 GHz
L1 Cache:	30 MB
L2 Cache:	14 MB

(a) The specification has 24 threads and 9 cores. Do you think this is an error? Justify your answer with ONE reason.

YES ☐ NO ☐

(2)

(b) What is the difference between L1 and L2 cache?

(2)

(c) L1 processor cache can either be dedicated or shared. Dedicated means that each core is allocated its own cache, while shared means all cache is used by all the processor cores. We don't know if the L1 cache in this example is shared or dedicated. What do you believe is the most likely? Justify your answer with ONE reason.

Dedicated ☐ Shared ☐

(2)
[28]

38 marks

SECTION C INTERNET AND COMMUNICATION TECHNOLOGIES

QUESTION 4 THEORY

For Questions 4.1 to 4.5, you need to select **the most correct answer** from the options A–D. An answer grid for your answers is at the bottom of this page. You merely need to write down the appropriate letter for your answer.

4.1 Signal attenuation occurs …

A when large packets of data are transmitted.
B when a signal is not transmitted in binary.
C when a signal is transmitted over a long distance.
D when the receiver of the signal doesn't receive the signal correctly. (1)

4.2 A hybrid network topology can be defined as:

A a combination of two or more network topologies.
B any topology designed for a specific network.
C a topology that does not need a switch.
D a network design that uses fibre optic and copper cables. (1)

4.3 A network bridge …

A amplifies a signal.
B connects two LAN segments that use the same protocol.
C sees two networks as a single entity.
D All of the above. (1)

4.4 ARP …

A is another name for the first network.
B associates MAC addresses and IP addresses.
C only works on Ethernet LANs.
D isn't essential in IP networking. (1)

4.5 A hotspot …

A will always ensure encrypted data transfer.
B can only be found in public places.
C is created to share private data.
D can connect devices using Bluetooth. (1)

Question	4.1	4.2	4.3	4.4	4.5
Answer					

[5]

QUESTION 5 APPLICATION

Start2Travel has a website that customers use to book flights. Staff who work for **Start2Travel** work from home. They can assist customers with bookings and make bookings for customers. The owner of **Start2Travel** runs the company from his home.

5.1 The owner of **Start2Travel** has a 4 Mbps fibre connection at his home that is used by his family and for the business.

5.1.1 Assuming the link is working at its advertised speed, how much data will be able to be transferred per second? State your answer in **bits per second**.

_____

_____

(2)

5.1.2 The owner has heard that an Internet connection should be a symmetric connection with similar upload and download speeds.

(a) Most domestic Internet connections are usually asymmetric. Give ONE reason why an asymmetric connection is suitable for home use, and give ONE example of data that will be uploaded and ONE example that will be downloaded.

Reason	
Upload example	
Download example	

(3)

(b) How will the owner determine if his connection is symmetric or asymmetric?

(1)

(c) Give ONE reason why a symmetric connection is not essential given its current use.

(1)

(d) How can this be changed if the connection turns out to be asymmetric (upload and download speeds are not similar)?

(1)

5.1.3 The company website is currently hosted in Johannesburg. The URL is <www.start2travel.co.za>. The IP address for the website is 104.32.66.89

(a) What is the name of the protocol that relates the IP address of a website to its URL, ensuring users do not need to remember or enter the IP address to access a website?

(1)

(b) The IP address of a website generally remains constant. Give ONE reason why the IP address might change.

(1)

(c) If the IP address does change, will the URL need to change? Justify your answer with ONE reason.

YES ☐ NO ☐

(2)

5.1.4 At his home office, the owner of **Start2Travel** has a wireless access point (WAP). This device also acts as the router for his Internet connection. The WAP currently has the following IP address: 172.35.55.100.

(a) Devices on the home office network obtain their IP addresses from the WAP. What is the name given to the protocol that dynamically allocates IP addresses to devices connected to an access point/router?

_____

_____

(1)

(b) The network has the following devices: a server, a laptop, a mobile phone and a network printer. Select ONE device that MUST have a static IP address and ONE device that can have a dynamic IP address. Give ONE reason for each answer.

	Device	**Reason**
Static		
Dynamic		

(4)

5.1.5 The owner has now decided to host the website himself at the home office to save money. He will use the server specified in Question 3.2.5 for this purpose.

(a) Do you believe the owner will need to increase the speed of his fibre connection? Justify your answer with ONE reason.

YES ☐ NO ☐

(2)

(b) Will the IP address of the website need to change? Explain your answer by suggesting which IP address will need to be associated with the website.

YES ☐ NO ☐

(2)

(c) A user downloads a document from the website. Name and explain TWO protocols that will be used to transfer this data.

Protocol	Purpose

(4)

(d) The website has been designed according to Web 2.0 principles. Name TWO design features that are essential for a Web 2.0 website.

Feature 1	
Feature 2	

(2)

5.2 The WAP that **Start2Travel** is using acts as the router for the network.

Show the difference between a router and a network switch by completing the table below. Tick the appropriate box under the heading 'Network switch' or 'Router'.

Factor	Network switch	Router
Connects nodes on a star network		
Uses the MAC address embedded in a frame		
Uses the MAC address and IP address embedded in a frame		
Boosts the signal received		
Determines the best path for packets to follow		

(5)
[32]

37 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 6

6.1 A customer has contacted one of the employees regarding a booking. The customer says that they did a search the day before for flights between Durban and Cape Town on the **Start2Travel** website and were quoted a certain price. Today, they did the same search on the **Start2Travel** website and were quoted a higher price.

Give TWO reasons why the price quoted might have changed. ONE of the reasons must be related to searching for ticket prices with a web browser.

Reason 1: _____

_____

Reason 2: _____

_____

(2)

6.2 The customer in Question 6.1 mentioned using a Virtual Private Network (VPN) to access the booking website.

6.2.1 What is a VPN?

_____

_____

_____

_____

(2)

6.2.2 While browsing with the VPN, the quoted price is given in US dollar. Give ONE reason why US dollar is used and not rand.

_____

_____

_____

_____

(1)

6.3 The following advert for flight tickets has gone viral on social media.

Start to Travel

Specialising in air travel since 1990

We are closing down our business and have a sale on all flight tickets. Example sales:
Durban to Johanesburg (one way) R100
Johanesberg to CapeTown (one way) R50
Limited tickets available – scan the Q.R. code to get yours now!

This advert was brought to the attention of the owner of **Start2Travel**. He has responded via social media to say that this is not true.

6.3.1 What is the general name given to incorrect information, such as this advert, that often circulates via social media?

_____

_____

(1)

6.3.2 List THREE items of information from the advert that indicate that the content is false.

Item 1: _____

_____

Item 2: _____

_____

Item 3: _____

_____

(3)

6.4 The employees of **Start2Travel** all work from home. Working from home decentralises the workplace.

List TWO advantages and TWO disadvantages of working from home in this scenario. These may not be the opposite of each other.

	Advantage	**Disadvantage**
1		
2		

(4)

6.5 An employee has been saving information regarding bookings and customers to his or her personal Google Drive. This employee's Google account was hacked. The employee states that they had not been told that they should not store data on a shared drive such as Google Drive and that **Start2Travel** had not provided an alternative shared network drive.

6.5.1 What document should **Start2Travel** have in place so there is agreement on a matter like this?

_____

_____

(1)

6.5.2 If **Start2Travel** had a company Google Drive account, all employees could use the shared information. Give ONE reason why this **might** pose a greater risk than employees using their own Google Drives.

_____

_____

(1)

6.5.3 The owner of **Start2Travel** wants to take some extra safety precautions due to the data hack. List TWO precautions that the owner could insist on to prevent data loss should an employee's laptop be stolen.

Precaution 1	
Precaution 2	

(2)

6.6 The owner is considering allowing Bitcoin payments for tickets. Blockchain technology is central to the support of currencies such as Bitcoin.

6.6.1 Explain why no individual entity can own a blockchain network.

_____

_____

(1)

6.6.2 Central to blockchain technology are the following properties: consensus, add-only, cryptographically secured, and distributed. Briefly describe any THREE of these properties showing why they are central to the operation of blockchain technology.

Property 1: _____

_____

Property 2: _____

_____

Property 3: _____

_____

(3)

21 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 7

Start2Travel will store a range of information regarding clients and bookings. They will have a database with multiple tables and an OOP-designed application that will pass SQL queries to the database. Some data manipulation will also occur using objects and arrays in the OOP application.

7.1 The database stores data relating to passengers and flights in a table named **tblFlightData**. The table has the following fields:

tblFlightData

TicketID	A unique field assigned to each ticket sold for a flight
PassengerID	A unique field assigned to each passenger on a flight
PassengerName	The full name of a passenger flying on a particular flight
FlightNumber	A unique field assigned to each flight between two cities
Origin	The name of the origin city for a flight
Destination	The name of the destination city for a flight

Sample data for this table is shown below:

TicketID	PassengerID	PassengerName	FlightNumber	Origin	Destination
1	SM3049	Jane Smith	KF001	Durban	Johannesburg
2	FE6651	Bero Fercando	KF001	Durban	Johannesburg
3	MF6651	Petrus Mfundi	DG023	Cape Town	Durban
4	MO3376	Ismail Mohammad	DG021	Durban	Cape Town
5	BE2219	Hilda Bennett	KF021	Johannesburg	Durban

7.1.1 The field ***TicketID*** is the key field in this table. What is meant by a *key field*?

(1)

7.1.2 It has been suggested that ***PassengerID*** could also be a key field. Justify why this would not, on its own, be a suitable key field.

(2)

7.1.3 If ***TicketID*** and ***PassengerID*** were combined to form the key field, would this create a better key than just ***TicketID*** on its own? Justify your answer with ONE reason.

YES ☐ NO ☐

(2)

7.1.4 Study the following SQL query written to determine the total number of passengers flying to Johannesburg.

```
SELECT SUM (PassengerID) AS CountPassengers
FROM tblFlightData
WHERE Destination = 'Johannesburg';
```

(a) This query produces an error when it is run. Explain what is causing the error and name the correct SQL function that will produce the intended output.

(3)

(b) If we wished to change the query to include data for a second city, such as Cape Town, which of the following would be correct? Justify your answer.

AND 'Cape Town' ☐

OR 'Cape Town' ☐

(2)

7.2 One of the programs used by **Start2Travel** is used to work with data relating to flights or bus journeys that have been booked. The program will create an object for each journey. A journey will be between any two cities. All bookings will be return bookings, i.e. the passenger will return to their original city.

The Journey class

This class will be used to instantiate **Journey** objects, one object for each journey booked through **Start2Travel**. A **Journey** object will have the following fields:

journeyCode : string
origin : string
destination : string
price : real
travelType : character

These fields should only be accessible from the **Journey** class.

The Ticket class

This class will be used to instantiate **Ticket** objects. A **Ticket** object will comprise two **Journey** objects and will have the following fields and types:

ticketID : integer
customerName : string
departure : **Journey**
return : **Journey**

These fields should only be accessible from inside the **Ticket** class.

The TicketManager class

This class will be used to manage an array of **Ticket** objects. **Journey** and **Ticket** objects will be instantiated using the data read from a text file and stored in an array of **Ticket** objects defined in this class. There will also be an integer field to record the number of **Ticket** objects added to the array.

tArr : array of **Ticket** objects
size : integer

7.2.1 Complete the class diagrams for the **Journey** and **Ticket** classes. Show the declaration of all the fields and the following for each class:

Journey Class

- Parameterised constructor method accepting the following parameters: **jC** (string), **o** (string), **d** (string), **p** (real), **tT** (character);
- Accessor method for the **travelType** field;
- Mutator method for the **travelType** field that will accept a parameter **tTIn** (character);
- A **toString()** method to combine the various fields of a **Journey** object into a string.

Ticket Class

- Parameterised constructor method that accepts parameters **tI** (integer), **n** (string) **d** (**Journey**), **r** (**Journey**);
- Mutator methods for the **departure** and **return** fields that will each accept a **Journey** object (**jIn**) as a parameter;
- A **toString()** method to combine the various fields of a **Ticket** object into a string.

Journey
Fields:
Methods:

Ticket
Fields:
Methods:

(8)

7.2.2 Each **Journey** object contains a field that holds the price of the journey from one city to another (stored in the field ***price***). We need to code a method that will calculate and return the **total price** of the round trip, i.e. the price of the two journeys.

(a) In which class would you include this method? Justify your answer with ONE reason.

Journey class ☐ Ticket class ☐ TicketManager class ☐

(2)

(b) Will this method be **typed/function** or **void/procedure**? Justify your answer with ONE reason.

typed/function ☐ void/procedure ☐

(2)

7.2.3 Three terms associated with OOP are: encapsulation, polymorphism and method overriding. Which of these concepts are used in the three classes in this question? Justify each answer and give examples where the concept **is** used.

Concept	YES	NO
Encapsulation		
Polymorphism		
Method overriding		

Justification:

Encapsulation	
Polymorphism	
Method overriding	

(6)

7.3 Consider the following algorithm that is written for the **TicketManager** class to search for the details of a particular object. Assume any additional methods (not in the class diagrams you drew in Question 7.2.) used in the algorithm have previously been coded.

Consider the following array of **Ticket** objects that has been instantiated in the **TicketManager** class. Only the ticketID and name fields are shown. Remember, they each contain a **Journey** object.

Element	tArr[0]	tArr[1]	tArr[2]	tArr[3]	tArr[4]
ticketID	1150	120	644	344	5443
name	Jane Smith	Bero Fercando	Petrus Mfundi	Ismail Mohammad	Hilda Bennett

These are currently the only objects in the array, hence the variable **size** has a value of 5. When the method is called, the parameter ***searchFor*** is passed the value 644.

```
method search(int searchFor)
begin
1    pos = 0;
2    for j ← 0 to size – 1 inc by 1
     begin
3        if searchFor = tArr[j].getTicketID
         begin
4            pos = j;
          end if
    end for
5   return(tArr[pos+1].getName)
end method
```

7.3.1 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. You need to include the line numbers as reference to the line of code in the algorithm. There are more lines on the grid than are necessary for a correct answer.

Line	size	pos	searchFor	j	searchFor = tArr [j] ?	Return
	5					

(7)

7.3.2 There is an error in this algorithm producing an incorrect result.

(a) Which line of the algorithm has the incorrect code?

_____

_____ (1)

(b) Explain the error that you have identified in Question 7.3.2 (a) above.

_____

_____ (1)

(c) The method currently searches through all elements of the array even after the search value was found. Suggest ONE way the algorithm could be improved so that it stops when the correct element is found.

_____

_____ (1)

7.4 **Start2Travel** has a special offer on a particular day when they will give customers loyalty points.

The following rules are used to decide if a customer qualifies for the loyalty points:

- Departure flight is from Durban – let this equal **D**
- Return flight is to Johannesburg – let this equal **J** **OR**
- Return flight is to Cape Town – let this equal **C**

This can be represented as: F(D,J,C) = (D.J + D.C)
The son of one of the employees at **Start2Travel** is studying IT and has written the following function to be the opposite, i.e. when customers do NOT earn loyalty points:

F(D,J,C)' = (D'+J') + (D'+C')

Complete the truth tables below to determine if **(D.J) + (D.C)** is the opposite of **(D'+J') + (D'+C')**.

D	J	C	D.J	D.C	(D.J) + (D.C)	RESULT
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

D'	J'	C'	D'+J'	D'+C'	(D'+J') + (D'+C')	RESULT
1	1	1				
1	1	0				
1	0	1				
1	0	0				
0	1	1				
0	1	0				
0	0	1				
0	0	0				

The two functions:

Produce the same results ☐

Produce different results ☐

(11)

49 marks

Total: 150 marks

ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.

