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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2022

INFORMATION TECHNOLOGY: PAPER II

EXAMINATION NUMBER

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 34 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. Two blank pages (page 33 and 34) 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	10	13	24	10	28	15	50	**150**
Marked								
Moderated								
Re-Mark								

SECTION A SHORT QUESTIONS

QUESTION 1 DEFINITIONS

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

1.1 A set of rules for exchanging information between two devices or two different computer systems.

_____

(1)

1.2 The process of converting typed or written text into machine-encoded text, usually from a scanner.

_____

(1)

1.3 A step-by-step solution to a problem written in a logical order.

_____

(1)

1.4 The portion of a CPU responsible for directing all activity.

_____

(1)

1.5 The delay before a component response occurs following an instruction.

_____

(1)

1.6 An encryption protocol for wireless networks that generates a different encryption key for each packet of data.

_____

(1)

1.7 A technique employed to increase the operational speed of a component.

_____

(1)

1.8 A number of Internet-connected devices often used to perform a Distributed Denial-of-Service attack.

_____

(1)

1.9 A collection of parallel wires on a motherboard used for transferring data between components.

_____

(1)

1.10 A type of cable that uses light to transfer data.

_____

(1)

10 marks

SECTION B SYSTEM TECHNOLOGIES

QUESTION 2 THEORY

2.1 The machine cycle consists of FOUR stages that are executed for each instruction that needs to be processed.

2.1.1 Name these four stages.

Stage 1	
Stage 2	
Stage 3	
Stage 4	

(4)

2.1.2 Which TWO of these stages will always interact with memory?

_____

_____

(2)

2.1.3 One of the components of the CPU that is used in the cycle is the ALU.

(a) What is the function of the ALU?

_____

_____

(1)

(b) Which stage of the machine cycle will interact with the ALU?

_____

_____

(1)

2.2 The instructions that a processor executes are written in machine code. Assume you have written a program in Java or Delphi.

2.2.1 Give TWO reasons why programming languages such as Java or Delphi are referred to as 'high-level languages'?

Reason 1:

Reason 2:

(2)

2.2.2 The code you have written is not machine code. What is the name given to the code written by the programmer?

(1)

2.2.3 What software is used to convert high-level languages into machine code?

(1)

2.2.4 Give an example of a low-level language.

(1)
[13]

SCENARIO

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

Trippy Trips is a company that operates an e-hailing* service provider in city areas. They specialise in transporting passengers over short distances. The service is operated from an office with only the owner working there. Customers use an app to order a driver and vehicle.

e-hailing: The process of ordering transportation, typically a taxi, via an app on a mobile device. A typical example is Uber.

QUESTION 3 APPLICATION

The owner of **Trippy Trips** is interested in buying a new computer for the office. He is unsure if he should do this or upgrade the current computer. He has asked your advice and has asked some questions regarding some main components of the system, including RAM, disk drives and the CPU.

3.1 Modern desktop computers are often designed to be upgraded.

3.1.1 Explain what is meant by the concept *modular design*?

_____

_____

(1)

3.1.2 Explain which of the following components of a desktop computer are likely to be replaced/upgraded, without adding any additional hardware.

Component	**Explanation**
Power supply	
USB 1.0 ports	
CPU	

(3)

3.2 You discover that the processor in the office computer is a Pentium 4 processor with the following specifications:

Cores : 1
Processor frequency : 3.00 Ghz
Cache : 1 MB Level 2
Bus speed : 800 Mhz

The processing power of the machine needs to be improved.

3.2.1 Explain why the processor does **not** support multiprocessing.

_____

_____

(1)

3.2.2 One way to improve the performance of this computer might be to add a maths co-processor.

(a) What is the function of a maths co-processor?

_____

_____

(1)

(b) Do you believe it is likely that you will be able to add a maths co-processor to this machine? Justify your answer with ONE reason.

YES ☐ NO ☐

_____

_____

(2)

3.2.3 The current processor supports hyper-threading.

(a) Define *hyper-threading*.

_____

_____

_____

_____

(2)

(b) Explain how hyper-threading helps to improve the performance of a processor.

(2)

3.3 Primary and secondary storage speed can also play a large part in the efficiency of a computer.

3.3.1 What data and/or applications are stored in:

Primary storage

(1)

Secondary storage

(1)

3.3.2 The current secondary storage device is a hard disk drive (HDD). The owner has been advised to change this to a solid-state drive (SSD).

(a) List ONE similarity and ONE difference between an HDD and an SSD. Your answers may not be the opposite of each other.

Similarity:	
Difference:	

(2)

(b) Explain WHY changing from an HDD to an SSD will improve the performance of the PC in the **Trippy Trips** office.

(2)

3.4 You have visited the offices of **Trippy Trips** to look at their current computer before making some recommendations about changes to the machine. While investigating, you notice something odd with the IRQ (interrupt request) values that have been assigned.

3.4.1 What is meant by an interrupt?

(2)

3.4.2 Each device on a computer is assigned an IRQ. Each IRQ is an indication of the importance of the device when it comes to the attention of the processor. A lower IRQ indicates a more important device in terms of the CPUs attention. Look at the list of devices and IRQs shown in the table below and explain why they have been assigned that IRQ.

Device	Suggested IRQ	Explanation
Keyboard	1	
USB Port	5	
System Timer/Clock	0	
HDD Controller	15	

(4)
[24]

37 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. There is an answer grid at the bottom of this page for your answers. Write down the appropriate letter for your answer.

4.1 Bluetooth …

A is a short-range wireless technology.
B is only used to connect devices like a mouse or keyboard.
C has a transfer rate too slow to transmit audio files.
D is only used in computers. (1)

4.2 IPV6 addresses …

A are stored in 64 bits.
B cannot be used instead of a URL in a browser.
C are represented in hexadecimal.
D are commonly used in most school networks. (1)

4.3 Smart clients …

A store data remotely.
B process data locally.
C do not need a constant Internet connection.
D All of the above. (1)

4.4 EMI …

A is not caused by magnetic fields.
B does not pose a security threat.
C does not affect fibre optic cables.
D cannot cause data loss. (1)

4.5 A VPN …

A can only be used to ensure anonymous browsing.
B extends a private network over a public network.
C cannot be used as a remote access tool.
D stores encrypted copies of all traffic transmitted. (1)

Question	4.1	4.2	4.3	4.4	4.5
Answer					

4.6 For each of the protocols shown in the table below, provide a brief explanation of what each is used for. There is an example to guide you in answering.

Protocol	**Use**
SMTP	Sending emails
HTTP	
FTP	
WebDav	

(3)

4.7 Name TWO devices that allow biometric input to be used to secure access to a laptop computer.

Device 1:	
Device 2:	

(2)
[10]

QUESTION 5 APPLICATION

Trippy Trips are expanding their business. Currently there is just one person (the owner) working in the office. Soon there will be THREE other people working in the office assisting with running the business. The office will need to be upgraded to include a network of computers – one for each employee – as well as mobile devices.

5.1 The first consideration for the network in the office will be a topology.

5.1.1 What is meant by a network topology?

_____

_____

(1)

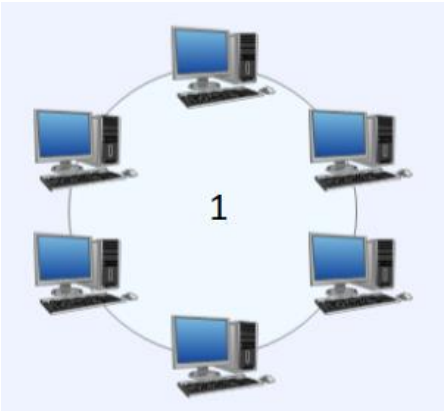
5.1.2 **Trippy Trips** have decided to use a star topology.

State ONE advantage and ONE disadvantage of a star topology. Your answers may not be the opposite of each other.

Advantage:	
Disadvantage:	

(2)

5.1.3 Examine the diagrams below that represent TWO different network topologies. What are topologies 1 and 2 called?



1	
2	

(2)

5.2 Having decided on the star topology for the network, **Trippy Trips** need to purchase some additional hardware. Study the specifications for the two devices shown below, and then answer the questions that follow.

Device A

- Switch layer: L2/L3
- RJ-45 Ethernet ports type: Gigabit Ethernet (10/100/1000)
- RJ-45 Ethernet ports quantity: 8
- MAC address table: 8000 entries

Device B

- Switch layer: L3
- RJ-45 Ethernet ports type: Gigabit Ethernet (10/100/1000)
- RJ-45 Ethernet ports quantity: 8
- MAC address table : 5000 entries
- 2.4GHz wireless
- Power over Ethernet (PoE)

5.2.1 Both devices have eight Ethernet ports.

(a) What is meant by *Ethernet*?

_____

_____

(1)

(b) Will eight ports be sufficient for the current needs in the **Trippy Trips** office? Justify your answer with ONE fact.

YES ☐ NO ☐

_____

_____

(2)

(c) The numbers 10/100/1000 refer to the speed at which data can be transmitted through the Ethernet ports. What is the most common unit of measurement for this speed?

_____

_____

(1)

(d) Explain why the ports on the devices need to run at these different speeds. Include in your answer an example of ONE device that might connect at the middle speed of 100.

Explanation:

Device example:

(3)

5.2.2 Device B has a few additional features over Device A. One of these is described as '2.4 GHz wireless'.

(a) Will this feature be useful for the **Trippy Trips** office? Justify your answer with ONE fact referenced from the scenario, considering that three new people are joining the office.

YES ☐ NO ☐

(2)

(b) Assuming **Trippy Trips** purchase Device A rather than Device B. What additional device will be needed to provide the same wireless functionality as Device B?

(1)

(c) How will the device in (b) above connect to the network?

(1)

5.2.3 Both devices have a 'MAC address table'. Shown below is an example of such a table from a similar device.

```
          Mac Address Table
-------------------------------------------
Vlan    Mac Address       Type        Ports
----    -----------       --------    -----
   1    00ld.70ab.5d60    DYNAMIC     Fa0/2
   1    00le.f724.al60    DYNAMIC     Fa0/3
Total Mac Addresses for this criterion: 2
```

Why is a list of MAC addresses important for Device A or B?

_____

_____

(1)

5.2.4 Device B also has a feature called Power over Ethernet (PoE). PoE is a feature that allows for a device that connects to one of the Ethernet ports to be supplied with an electrical current as well as normal Ethernet traffic.

Suggest ONE advantage and ONE disadvantage of using PoE for connected devices. These may not be the opposite of each other.

Advantage:	
Disadvantage:	

(2)

5.3 Drivers who work for **Trippy Trips** want to offer free Wi-Fi access to customers while they are being transported by the driver in their vehicles by creating a Wi-Fi Hotspot in the taxi.

5.3.1 Do you think it is important for the Wi-Fi hotspot to be password protected? Justify your answer with TWO reasons.

YES ☐ NO ☐

Reason 1:	
Reason 2:	

(3)

5.3.2 As a **Trippy Trips** driver, give TWO types of activities you would allow and TWO activities you would prevent/block customers from performing while using your hotspot. Your items must not be the direct opposite of each other and must be dissimilar activities.

	Allow	**Block**
Name of activity		
Name of activity		

(4)

5.3.3 There are two ways in which a driver could offer the hotspot feature:

Method 1: Create a Wi-Fi hotspot using the driver's mobile phone, which is used to communicate with the **Trippy Trips** app as well as for navigation; OR

Method 2: Purchase a separate 3G router to create a Wi-Fi hotspot for customers to connect to.

Which method, 1 or 2, is better for allowing connectivity? Justify your answer with ONE reason.

Method 1 ☐ Method 2 ☐

_____

_____

_____

_____

(2)
[28]

38 marks

SECTION D SOCIAL IMPLICATIONS

QUESTION 6

Read the following extract from an article dealing with **data privacy** and answer the questions that follow.

Data is the pulse of modern life, a valuable thread that runs through so many things, making data privacy very important.

Data's reach into our lives is huge and has an influence on:

- The adverts you see – consider behavioural tracking,
- the music you listen to on apps like Spotify,
- who you might match up with on the latest dating app,
- who gets a personal loan, and even,
- which political party wins elections – remember the Facebook–Cambridge Analytica data scandal?

It's not only businesses that use data. Society also benefits from data flowing freely. Some of the benefits include:

- Farmers using AI (Artificial Intelligence)-powered drones to manage water levels in their crops, or
- the University of Texas finding a COVID vaccine based on AI, and
- geolocation data enabling us to find missing children.

But in the wrong hands, it can also be dangerous.

Therefore, it's important to uphold the data protection laws that guide us on how to process personal data lawfully. These laws help regulate how we use personal data to ensure we have a just and fair society in which people have their own sovereignty and autonomy.

The laws set the rules for what we may and may not do with data and are an important part of protecting people from harm.

[Adapted from: <https://www.michalsons.com/blog/why-is-data-privacy-important/55190> (Accessed 25 January 2022)]

6.1 What is the full name of the law in South Africa that aims to protect personal data?

_____

_____

(1)

6.2 List TWO methods that **Trippy Trips** might use to alert customers that they will be collecting their personal data.

Method 1: _____

_____

Method 2: _____

_____

(2)

6.3 Think of THREE examples of personal data items that **Trippy Trips** might collect about a customer.

Complete the table below to name the data items and how they might be lawfully used by **Trippy Trips**. Assume that customers have given permission to store and process these data items.

There is an example in the first row of the table. You may not use the same example in your answers, and your answers in column B must differ from one another.

A: Data item	**B: Lawful use**
Customer name	To maintain a database of customers

(6)

6.4 The safety of data is important. Data collected by **Trippy Trips** will be stored in a database.

Name and explain TWO security measures to ensure that the data is protected and complies with the law. There is an example in the first row of the table. You may not use the same example in your answers, and your answers in column B must differ from each other.

A: Security measure	B: Explanation
Database password	Only employees who have the password will be able to process data.

(4)

6.5 Assume that the data in the **Trippy Trips** database is hacked. List TWO actions that the owner must take immediately in terms of the relevant law.

Action 1: _____

_____

Action 2: _____

_____

(2)

15 marks

SECTION E DATA AND INFORMATION MANAGEMENT AND SOLUTION DEVELOPMENT

QUESTION 7

The **Trippy Trips** database that stores customer information is accessed using both SQL queries and via an OOP-based application.

7.1 When storing data in a database or other structure, consideration must be given to data types. Assume there is a data value that is being stored as a **signed real number** in the following format:

	Exponent							Mantissa																							
31	30						23	22																							0
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

7.1.1 The data in bit 31 relates to the mantissa. What is this value called?

_____

(1)

7.1.2 Write down the formulae to determine the largest and smallest **signed** values that can be stored in the exponent.

Largest	**Smallest**

(2)

7.1.3 Look at the mantissa.

(a) How many bits are allocated to the mantissa?

_____

(1)

(b) What is the largest value which can be stored in the mantissa? Show your calculations using the appropriate formula.

(2)

7.2 One of **Trippy Trips's** programs is used to store and work with details of drivers who are employed by the company. The program makes use of objects to hold relevant information and is made up of many different classes. Data on driver ratings (how well the driver drove, whether the driver was courteous, etc.) will be included in one of the classes.

The Driver Class

This class will be used to instantiate **Driver** objects: one object for each driver employed by **Trippy Trips**. A **Driver** object will have the following fields:

name : string
vehicle : string
registration : string
chargeRate : real

These fields should be accessible from the **Driver** Class and any class that inherits from it.

The Rating Class

This class will be used to instantiate **Rating** objects for each driver. Ratings are given at the end of a journey. A **Rating** object will have the following fields and types:

rating : integer
comment : string
date : Date object

These fields should only be accessible from inside the **Rating** Class.

The PremiumDriver Class

This class will be used to instantiate **PremiumDriver** objects for all drivers who are part of a scheme that recommends drivers who have a high rating from previous customers. This class inherits from the **Driver** class. In addition to the inherited fields, objects instantiated from this class will include the following fields:

rArr : array of **Rating** objects
size : integer

These fields should only be accessible from inside the **PremiumDriver** Class.

7.2.1 Complete the class diagrams for the **Driver** and **PremiumDriver** classes. Indicate the relationship (if any) between the classes. Show the declaration of all the fields and methods of the following classes:

Driver Class

- Parameterised constructor method accepting the following parameters: **n** (string), **v** (string), **r** (string), **cR** (real);
- Accessor method for the **chargeRate** field;
- Mutator method for the **chargeRate** field, which will accept a parameter **cRIn** (real)
- A **toString()** method to combine the various fields of a **Driver** object into a string.

PremiumDriver Class

- Parameterised constructor method that accepts parameters **rtG** (array of **Rating** objects) and **s** (integer) in addition to the parameters of the parent class;
- Mutator method for the **Ratings** array called **rArr**, which will accept a **Ratings** array (**dArr**) as a parameter;
- A **toString()** method to combine the various fields of a **Driver** object into a string.

Driver
Fields:
Methods:

PremiumDriver
Fields:
Methods:

(10)

7.2.2 Consider the **PremiumDriver** and **Rating** classes. Shown below is an example of an object instantiated from the **PremiumDriver** class.

Field	**Value**	
name	`Bongi Nzuza`	
vehicle	`Nissan`	
registration	`CA 332 221`	
chargeRate	`8.50`	
size	`3`	
rArr[0]	rating	`5`
	comment	`A safe driver who was very courteous`
	date	`23/10/2020`
rArr[1]	rating	`1`
	comment	`Was not on time and exceeded the speed limit`
	date	`20/11/2020`
rArr[2]	rating	`4`
	comment	`Was friendly and smiled a lot`
	date	`24/11/2020`

We need to code a method in the **PremiumDriver** class that will be used to change the rating field of any object in the array of **Rating** objects for any premium driver.

(a) This question relates to the **Rating** class. Write down a suitable method header for a mutator method called **setRating()** that will be coded in the **Rating** class. The method will be sent a new rating as an integer parameter named **inR**.

_____

(1)

(b) This question relates to the **PremiumDriver** class. Write the code for a method called **changeRating()** in the **PremiumDriver** class. This method will accept two integer parameters:

- an integer called **inInd** that indicates the index of the **Rating** object (starting from 0) to be changed.
- the new rating value as an integer called **inNewR**.

The method must call the **setRating()** method in the **Rating** class.

(3)

(c) Consider the following method that is added to a **Manager** class that instantiates an array of **Driver** or **PremiumDriver** objects named **dArr**:

JAVA:
```
public PremiumDriver getPremiumDriver(int i)
 {
        return (PremiumDriver) dArr[i];
 }
```

DELPHI:
```
function TSomeManagerClass.getPremiumDriver( i : integer) :
TPremiumDriver
begin
        result:= dArr[i] as TPremiumDriver;
end
```

(i) What is the purpose of this accessor method?

(1)

(ii) Why is the code **(PremiumDriver)** included between the words ***return*** and ***dArr[i]*** in Java; and the code ***as TPremiumDriver*** included in the **result** assignment statement in Delphi?

(1)

7.2.3 Does the **PremiumDriver Class** make use of method overriding? Justify your answer with ONE reason. Your reason must refer to method names and classes where necessary.

YES ☐ NO ☐

(3)

7.2.4 **Trippy Trips** have decided that all drivers are going to be assigned the same charge rate. What change should be made to the design of the **Driver** class to best accommodate this change?

(2)

7.3 Consider the following algorithm that has been written to be coded into a method that will be used to calculate the average rating of premium drivers for a particular day in the year, in this instance, 24 December 2021.

Also consider the following array of **PremiumDriver** objects:

Element	rArr[0]	rArr[1]	rArr[2]	rArr[3]	rArr[4]
Rating	3	5	2	4	2
Comment	xyz	abc	jbj	klk	bby
Date	24/12/2021	23/12/2021	24/12/2021	24/12/2021	24/12/2021

Remember that the **PremiumDriver** class has a variable **size** with a value of **5** indicating the number of **Rating** objects in the array called **rArr** for an individual **PremiumDriver**.

```
method calculateAverage() : real
begin
1       avg ← 0.0
2       total ← 0
3       count ← 0
4       for k ← 0 to size – 1 inc by 1
        begin
5               if rArr[k].getDate() = 24/12/2021
                begin
6                       total ← total + rArr[k].getRating()
7                       count++
8               else    total ← total – rArr[k].getRating()
                end if
        end for
9       avg ← total / count
10      return avg
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	avg	total	count	k	arr[k].getDate = 24/12/2021 ?	Return
	5						

(10)

7.3.2 There is an obvious error in this algorithm that is resulting in an incorrect calculation.

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

_____

_____ (1)

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

_____

_____ (1)

(c) The method currently hard codes the date that is being tested. What will be a better way to code this to make the method more generic?

_____

_____ (1)

7.4 **Trippy Trips** would like to reward drivers based on certain criteria. There is an additional class that has been coded that has details of the different areas a driver collects passengers from.

Trippy Trips' management wish to consider the following criteria:

- More than 10 trips in one evening – let this equal T.
- Passengers collected from more than 5 areas – let this equal A.
- Average driver rating of 4 – let this equal R.

You need to determine the correct combination of these criteria for an award to drivers according to the following:

((T AND A) OR (T AND R)) OR (T AND A AND R)

This can be represented as: F(T,A,R) = (T.A + T.R) + T.A.R

7.4.1 Complete the truth table below to represent the condition F(T,A,R).

T	A	R	T.A	T.R	T.A + T.R	T.A.R	(T.A + T.R) + T.A.R	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						

(7)

7.4.2 Write out, using the correct notation, the function that represents the combination of all valid outcomes from the truth table.

F(T,A,R) = _____

_____

(3)

50 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.

